

Space Program Operations Contract

SPACE SHUTTLE ORBITER OPERATIONAL LEVEL C FUNCTIONAL SUBSYSTEM SOFTWARE REQUIREMENTS GUIDANCE, NAVIGATION AND CONTROL PART E

FLIGHT CONTROL - SENSOR/CONTROLLER SUBSYSTEM OPERATING PROGRAM

**Prepared by The Boeing Company
Space Exploration**

Under Subcontract 6000132079, PDRD P1433q

December 14, 2007

DRD 1.4.3.3-q

Contract NNJ06VA01C



STS 83-0015-34
December 14, 2007

This page intentionally left blank.



STS 83-0015-34

**SPACE SHUTTLE ORBITER OPERATIONAL LEVEL C
FUNCTIONAL SUBSYSTEM SOFTWARE
REQUIREMENTS
GUIDANCE, NAVIGATION, AND CONTROL PART E
FLIGHT CONTROL - SENSOR/CONTROLLER
SUBSYSTEM OPERATING PROGRAM**

Issue Date: December 14, 2007

**NASA Contract No. NNJ06VA01C, DRD 1.4.3.3-q
USA Subcontract 6000132079, PDRD P1433q
WBS 2.4.3.2**

The Boeing Company
Space Exploration

This page intentionally left blank.

Prepared by

/s/ **C. Bergman**

C. Bergman
FSSR Documentation

/s/ **D. Gavert**

D. Gavert

G4.39 ADTA SOP

/s/ **D. McCorvey**

D. McCorvey

G4.40 ORB RG SOP
G4.41 SRB RG SOP
G4.42 AA SOP
G4.51 BF SLEW SOP

/s/ **S. Everett**

S. Everett

G4.55 SBTC SOP
G4.59 NW POSN SOP

/s/ **T. Tanita**

T. Tanita

G4.53 2-AX RHC SOP
G4.56 RPTA SOP
G4.171 3-AX RHC SOP

/s/ **T. Gederberg**

T. Gederberg

G4.54 THC SOP
G4.199 ORB 3-AX RHC SOP

/s/ **L. Wood**

L. Wood

G4.216 FC SWIT PROC

/s/ **W. Dafler**

W. Dafler

G4.57 LDG SOP

Approved by

/s/ **D. Owen**

D. Owen, Product Manager
Flight Software Requirements & Verification
Flight Software Team

Approved by

/s/ **D. Bateman**

D. Bateman, Manager
FSSR Documentation
Flight Software Team

This page intentionally left blank.

FOREWORD

The primary avionics software system (PASS) requirements for the computer programs that execute in the Shuttle general-purpose computers (GPCs) are specified in the Computer Program Development Specifications (CPDSs) and the Functional Subsystem Software Requirements (FSSR) documents. The requirements are specified at three levels:

- Level A CPDS – System-level constraints and capabilities
- Level B CPDS – Functional requirements
- Level C FSSR – Detailed-level requirements

The Level A CPDS specifies system-level constraints and capabilities that are not oriented toward any particular program end item. The Level B CPDS specifies system-level requirements for guidance, navigation and control (GN&C) and detailed requirements for systems management (SM) and vehicle utility (VU). The Level C FSSR's specify the detailed requirements for GN&C and display/controls. The Level C reconfigurable requirements are specified in the systems management and payload documents. The Level A, Level B and Level C requirements documents are listed in Section 2, Applicable Documents.

This page intentionally left blank.

DOCUMENT CHANGE RECORD

The following tabulation summarizes the change activity associated with this document.

| DOCUMENT CHANGE RECORD | | | |
|------------------------------------|--|-----------|--|
| Issue and Date | Change Summary/Effectivity | | |
| OI-34 Release December 14, 2007 | This baseline release for effectivity OI-34 and subs includes: | | |
| | <u>CR</u> | <u>OI</u> | <u>Title</u> |
| | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| | 93160B | 32 | Year End Roll Over (YERO) Reset |
| | 93175 | 32 | Expand Effectivity of SCR 93160B |

This page intentionally left blank.

CHANGE REQUEST SUMMARY

The following tabulation lists the paragraphs, tables (T), and figures (F) that have been changed as a result of approved change requests for this release. Changes incorporated prior to this release are listed in Appendix R. Changes from approved change requests (CRs) to this document are indicated by a change bar in the outer margin of the changed page.

| CHANGE REQUEST SUMMARY | | | |
|-------------------------------|---------------|-----------|--|
| Paragraph | CR No. | OI | CR Title |
| N/A | 93175 | 32 | Expand Effectivity of SCR 93160B |
| 1.3-1.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.39-2.(T) | 93160B | 32 | Year End Roll Over (YERO) Reset |
| | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.39-3.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.40-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.40-3.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.41-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.41-3.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.42-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.42-23(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.53-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.54-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.55-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.55-3.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.56-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.57-3.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.57-4.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.59-5.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.59-6.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.171-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.199-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |
| 4.216-2.(T) | 93017G | 33 | Baseline RSS99D0100 with Expanded Downlist |

This page intentionally left blank.

Table of Contents

| <u>SECTION</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------|--|-------------|
| 1.0 | INTRODUCTION..... | 1 |
| 1.1 | PURPOSE | 1 |
| 1.2 | SCOPE..... | 1 |
| 1.3 | ORGANIZATION | 1 |
| 2.0 | APPLICABLE DOCUMENTS..... | 5 |
| 2.1 | LEVEL A DOCUMENTS | 5 |
| 2.2 | LEVEL B DOCUMENTS..... | 5 |
| 2.3 | LEVEL C DOCUMENTS..... | 5 |
| 2.4 | ICD DOCUMENTS..... | 6 |
| 3.0 | OVERVIEW | 7 |
| 3.1 | SHUTTLE OPERATIONAL PROGRAM | 7 |
| 3.2 | GN&C SOFTWARE REQUIREMENTS STRUCTURE | 7 |
| 3.3 | SOP OVERVIEW..... | 8 |
| 3.4 | SOP SUBSECTION ORGANIZATION | 9 |
| 3.5 | IMPLEMENTATION CONSTRAINTS | 11 |
| 3.6 | TIMING | 11 |
| 4.0 | DETAIL LEVEL REQUIREMENTS | 13 |
| 4.0.1 | Flight Control Effector SOP..... | 14 |
| 4.0.2 | Traceability | 15 |
| 4.0.3 | Documented Requirements Precedence | 17 |
| 4.39 | AIR DATA TRANSDUCER ASSEMBLY SOP | 18 |
| 4.39.1 | Overview..... | 18 |
| 4.39.2 | ADTA SOP Detail Level Requirements..... | 20 |
| 4.39.2.1 | ADS Air Data Calculations..... | 21 |
| 4.39.2.1.1 | Angle of Attack (AOA)..... | 22 |

Table of Contents

| <u>SECTION</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------|---|-------------|
| 4.39.2.1.2 | Static Source Error Correction (SSEC)..... | 25 |
| 4.39.2.1.3 | Pitot Source Error Correction (PSEC). | 27 |
| 4.39.2.1.4 | Mach Number (MACH). | 30 |
| 4.39.2.1.5 | Pressure Altitude (PRALT). | 31 |
| 4.39.2.1.6 | Pressure Altitude Correction (PRALTC)..... | 33 |
| 4.39.2.1.7 | Non-Standard Atmosphere Corrections for Temperature (NSATM)..... | 34 |
| 4.39.2.1.8 | Non-Standard Atmosphere Correction For Altitude (NSATMH). | 34 |
| 4.39.2.1.9 | U.S. Standard Atmosphere 1962 Model (STDATM)..... | 36 |
| 4.39.2.1.10 | Dynamic Pressure (DYPRS)..... | 36 |
| 4.39.2.1.11 | Equivalent Airspeed (EQAS). | 37 |
| 4.39.2.1.12 | Estimated True Airspeed (ETRAS)..... | 37 |
| 4.39.2.1.13 | Default Air Data Parameters (DEFAD). | 38 |
| 4.39.2.1.14 | Static Pressure Limiter (STLIM)..... | 39 |
| 4.39.2.2 | NAV/ADS/DEFAULT Air Data Transition..... | 40 |
| 4.39.2.3 | Left/NAV/Right Air Data Calculations..... | 41 |
| 4.39.2.3.1 | Pressure Altitude Rate (PARAT)..... | 42 |
| 4.39.2.4 | ADTA RM Air Data Calculations. | 43 |
| 4.40 | ORBITER RATE GYRO SOP..... | 87 |
| 4.41 | SRB RATE GYRO SOP..... | 99 |
| 4.42 | ACCELEROMETER ASSEMBLY SOP | 107 |
| 4.51 | BODY FLAP SLEW COMMAND SOP | 115 |
| 4.53 | TWO-AXIS ROTATIONAL HAND CONTROLLER SOP | 123 |
| 4.53.1 | RHC Compensation..... | 124 |
| 4.53.2 | RHC Deadbanding..... | 125 |
| 4.53.3 | RHC Discretes..... | 126 |
| 4.53.4 | RHC Station Select..... | 126 |

Table of Contents

| <u>SECTION</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------|---|-------------|
| | 4.53.5 Roll and Pitch Trim Station Select | 127 |
| 4.54 | TRANSLATION HAND CONTROLLER SOP | 135 |
| | 4.54.1 AFT THC Transformation | 135 |
| | 4.54.2 THC Station Select | 136 |
| 4.55 | SPEED BRAKE THRUST CONTROLLER SOP | 143 |
| | 4.55.1 SBTC Compensation | 144 |
| | 4.55.2 SBTC Station Select | 144 |
| | 4.55.3 SBTC Manual Throttle Processing | 144 |
| 4.56 | RUDDER PEDAL TRANSDUCER ASSEMBLY SOP | 155 |
| | 4.56.1 RPTA Compensation | 156 |
| | 4.56.2 RPTA Station Select | 156 |
| | 4.56.3 RPTA Deadbanding | 156 |
| | 4.56.4 YAW Trim Station Select | 157 |
| 4.57 | LANDING SOP | 165 |
| 4.59 | NOSE WHEEL POSITION SOP | 181 |
| | 4.59.1 Nose Wheel Position Compensation | 182 |
| | 4.59.2 Nose Wheel Position COMMFAULT Logic | 182 |
| | 4.59.3 Nose Wheel Position Comparison | 182 |
| | 4.59.4 Nose Wheel Position and Difference Filters | 187 |
| 4.171 | THREE-AXIS ROTATIONAL HAND CONTROLLER SOP | 201 |
| | 4.171.1 RHC Compensation | 203 |
| | 4.171.2 RHC Validation | 204 |
| | 4.171.3 Scalar Commands | 204 |
| | 4.171.4 Integer Commands | 205 |
| | 4.171.5 Discrete Commands | 206 |
| 4.199 | ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP | 215 |
| | 4.199.1 RHC Compensation | 218 |
| | 4.199.2 RHC Validation | 218 |

Table of Contents

| <u>SECTION</u> | <u>TITLE</u> | <u>PAGE</u> |
|-----------------------|--|--------------------|
| | 4.199.3 Scalar Commands..... | 218 |
| | 4.199.4 Integer Commands..... | 220 |
| | 4.199.5 Discrete Commands..... | 221 |
| 4.216 | FLIGHT CONTROL SWITCH SOP..... | 233 |
| | 4.216.1 Orbital DAP/Translation Switch Processing..... | 236 |
| | 4.216.2 Rotational Switch Processing..... | 236 |
| | 4.216.3 Rotational PBI Illumination Commands..... | 237 |
| 5.0 | FORMULATIONS..... | 247 |
| 6.0 | GLOSSARY..... | 339 |
| 6.1 | LIST OF DEFINITIONS..... | 339 |
| 6.2 | LIST OF ACRONYMS AND ABBREVIATIONS..... | 345 |
| APPENDIX R | CHANGE AUTHORIZATION REFERENCES..... | 351 |
| R.1 | CR REFERENCE SUMMARY..... | 351 |
| R.2 | HISTORICAL CHANGE REQUEST SUMMARY..... | 354 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|--------------|---|-------------|
| 1.3-1. | Parameter Element Description | 2 |
| 4.0.1-1. | Sensor/Controller SOP Operational Major Modes/Rates..... | 14 |
| 4.0.2-1. | Functional/Document Traceability | 15 |
| 4.0.2-2. | Sensor/Controller SOP FSSR/PRD Correlation..... | 16 |
| 4.39.1-1. | Air Data Parameter Execution Rates | 20 |
| 4.39.2-1. | Output Data Set Requirements | 41 |
| 4.39-1. | ADTA SOP Initialization Parameters | 45 |
| 4.39-2. | INPUT FUNCTIONAL PARAMETERS FOR AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)..... | 69 |
| 4.39-3. | OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)..... | 71 |
| 4.39-4. | AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS | 76 |
| 4.39-5. | AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) K-LOADS | 85 |
| 4.39-6. | AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) CONSTANTS | 86 |
| 4.40-1. | Orbiter RG SOP Initialization Parameters | 88 |
| 4.40-2. | INPUT FUNCTIONAL PARAMETERS FOR ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) | 90 |
| 4.40-3. | OUTPUT FUNCTIONAL PARAMETERS FROM ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40)..... | 91 |
| 4.40-4. | ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) I-LOADS | 93 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|---------------------|--|--------------------|
| 4.40-5. | ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) K-LOADS..... | 94 |
| 4.40-6. | ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) CONSTANTS..... | 97 |
| 4.41-1. | SRB RG SOP Initialization Parameters..... | 100 |
| 4.41-2. | INPUT FUNCTIONAL PARAMETERS FOR SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41)..... | 102 |
| 4.41-3. | OUTPUT FUNCTIONAL PARAMETERS FROM SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41)..... | 103 |
| 4.41-4. | SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) I-LOADS | 104 |
| 4.41-5. | SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) K-LOADS..... | 105 |
| 4.41-6. | SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) CONSTANTS..... | 106 |
| 4.42-1. | AA SOP Initialization Parameters | 108 |
| 4.42-2. | INPUT FUNCTIONAL PARAMETERS FOR ACCELEROMETER ASSEMBLY SOP (G4.42)..... | 110 |
| 4.42-3. | OUTPUT FUNCTIONAL PARAMETERS FROM ACCELEROMETER ASSEMBLY SOP (G4.42)..... | 111 |
| 4.42-4. | ACCELEROMETER ASSEMBLY SOP (G4.42) I-LOADS..... | 112 |
| 4.42-5. | ACCELEROMETER ASSEMBLY SOP (G4.42) K-LOADS | 113 |
| 4.42-6. | ACCELEROMETER ASSEMBLY SOP (G4.42) CONSTANTS | 114 |
| 4.51-1. | BF Slew SOP Initialization Parameters | 115 |
| 4.51-2. | INPUT FUNCTIONAL PARAMETERS FOR BODY FLAP SLEW COMMAND SOP (G4.51)..... | 117 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|---------------------|--|--------------------|
| 4.51-3. | OUTPUT FUNCTIONAL PARAMETERS FROM BODY FLAP SLEW COMMAND SOP (G4.51)..... | 118 |
| 4.51-4. | BODY FLAP SLEW COMMAND SOP (G4.51) I-LOADS | 119 |
| 4.51-5. | BODY FLAP SLEW COMMAND SOP (G4.51) K-LOADS | 120 |
| 4.51-6. | BODY FLAP SLEW COMMAND SOP (G4.51) CONSTANTS | 121 |
| 4.53-1. | Two-Axis RHC SOP Initialization Parameters | 124 |
| 4.53-2. | INPUT FUNCTIONAL PARAMETERS FOR TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) | 130 |
| 4.53-3. | OUTPUT FUNCTIONAL PARAMETERS FROM TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) | 131 |
| 4.53-4. | TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) I-LOADS | 132 |
| 4.53-5. | TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) K-LOADS..... | 133 |
| 4.53-6. | TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) CONSTANTS..... | 134 |
| 4.54-1. | THC SOP Initialization Parameters..... | 135 |
| 4.54-2. | INPUT FUNCTIONAL PARAMETERS FOR TRANSLATION HAND CONTROLLER SOP (G4.54)..... | 138 |
| 4.54-3. | OUTPUT FUNCTIONAL PARAMETERS FROM TRANSLATION HAND CONTROLLER SOP (G4.54)..... | 139 |
| 4.54-4. | TRANSLATION HAND CONTROLLER SOP (G4.54) I-LOADS | 140 |
| 4.54-5. | TRANSLATION HAND CONTROLLER SOP (G4.54) K-LOADS..... | 141 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|---------------------|--|--------------------|
| 4.54-6. | TRANSLATION HAND CONTROLLER SOP (G4.54) CONSTANTS..... | 142 |
| 4.55-1. | SBTC SOP Initialization Parameters..... | 143 |
| 4.55-2. | INPUT FUNCTIONAL PARAMETERS FOR SPEEDBRAKE THRUST CONTROLLER SOP (G4.55)..... | 148 |
| 4.55-3. | OUTPUT FUNCTIONAL PARAMETERS FROM SPEEDBRAKE THRUST CONTROLLER SOP (G4.55)..... | 149 |
| 4.55-4. | SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) I-LOADS | 151 |
| 4.55-5. | SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) K-LOADS..... | 152 |
| 4.55-6. | SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) CONSTANTS..... | 153 |
| 4.56-1. | RPTA SOP Initialization Parameters..... | 155 |
| 4.56-2. | INPUT FUNCTIONAL PARAMETERS FOR RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56)..... | 160 |
| 4.56-3. | OUTPUT FUNCTIONAL PARAMETERS FROM RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56)..... | 161 |
| 4.56-4. | RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) I-LOADS | 162 |
| 4.56-5. | RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) K-LOADS..... | 163 |
| 4.56-6. | RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) CONSTANTS..... | 164 |
| 4.57-1. | WOW Discrete Logic | 169 |
| 4.57-2. | Landing SOP Initialization Parameters..... | 173 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|---------------------|--|--------------------|
| 4.57-3. | INPUT FUNCTIONAL PARAMETERS FOR LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) | 174 |
| 4.57-4. | OUTPUT FUNCTIONAL PARAMETERS FROM LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) | 175 |
| 4.57-5. | LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) I-LOADS | 177 |
| 4.57-6. | LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) K-LOADS..... | 178 |
| 4.57-7. | LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) CONSTANTS..... | 179 |
| 4.59-1. | Nose Wheel Position SOP I-Loads | 184 |
| 4.59-2. | NWS Mode Interpretation Table | 189 |
| 4.59-3. | Position Filter Initialization Requirements** | 189 |
| 4.59-4. | Difference Filter Initialization Requirements** | 190 |
| 4.59-5. | INPUT FUNCTIONAL PARAMETERS FOR NOSE WHEEL POSITION SOP (G4.59)..... | 195 |
| 4.59-6. | OUTPUT FUNCTIONAL PARAMETERS FROM NOSE WHEEL POSITION SOP (G4.59)..... | 196 |
| 4.59-7. | NOSE WHEEL POSITION SOP (G4.59) I-LOADS | 197 |
| 4.59-8. | NOSE WHEEL POSITION SOP (G4.59) K-LOADS | 198 |
| 4.59-9. | NOSE WHEEL POSITION SOP (G4.59) CONSTANTS | 199 |
| 4.171-1. | Three-Axis RHC SOP Initialization Parameters | 202 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|--------------|--|-------------|
| 4.171-2. | INPUT FUNCTIONAL PARAMETERS FOR THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171)..... | 209 |
| 4.171-3. | OUTPUT FUNCTIONAL PARAMETERS FROM THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171)..... | 210 |
| 4.171-4. | THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) I-LOADS | 211 |
| 4.171-5. | THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) K-LOADS..... | 213 |
| 4.171-6. | THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) CONSTANTS..... | 214 |
| 4.199-1. | Orbital Three-Axis RHC Initialization Parameters..... | 216 |
| 4.199-2. | INPUT FUNCTIONAL PARAMETERS FOR ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199)..... | 227 |
| 4.199-3. | OUTPUT FUNCTIONAL PARAMETERS FROM ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199)..... | 228 |
| 4.199-4. | ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) I-LOADS | 229 |
| 4.199-5. | ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) K-LOADS..... | 231 |
| 4.199-6. | ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) CONSTANTS..... | 232 |
| 4.216-1. | FC Switch Processing Initialization Parameters | 234 |
| 4.216-2. | INPUT FUNCTIONAL PARAMETERS FOR FLIGHT CONTROL SWITCH PROCESSOR (G4.216)..... | 240 |

List of Tables

| <u>TABLE</u> | <u>TITLE</u> | <u>PAGE</u> |
|---------------------|---|--------------------|
| 4.216-3. | OUTPUT FUNCTIONAL PARAMETERS FROM FLIGHT CONTROL SWITCH PROCESSOR (G4.216)..... | 243 |
| 4.216-4. | FLIGHT CONTROL SWITCH PROCESSOR (G4.216) I-LOADS..... | 244 |
| 4.216-5. | FLIGHT CONTROL SWITCH PROCESSOR (G4.216) K-LOADS | 245 |
| 4.216-6. | FLIGHT CONTROL SWITCH PROCESSOR (G4.216) CONSTANTS | 246 |
| 5-1. | Requirements/Formulation Cross-Reference | 249 |
| R.1-1. | CR Reference Summary..... | 351 |
| R.2-1. | Historical Change Request Summary | 354 |

This page intentionally left blank.

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|--|--------------------|
| 4.39-1. | Air Data System Functional Block Diagram..... | 60 |
| 4.39-2. | ADS Air Data Calculation Block Diagram, OPS 3..... | 61 |
| 4.39-3. | ADS Air Data Calculation Block Diagram, OPS 6..... | 62 |
| 4.39-4. | OPS 3 GN&C Transition Logic Requirements | 63 |
| 4.39-5. | OPS 6 GN&C Transition Logic Requirements | 64 |
| 4.39-6. | Left/NAV/Right Display Logic Requirements..... | 65 |
| 4.39-7. | Left/Right Air Data Calculation Block Diagram (OPS 3 and 6)..... | 66 |
| 4.39-8. | ADS RM Calculation Logic Requirements | 67 |
| 4.39-9. | ADTA RM Air Data Calculations Block Diagram..... | 68 |
| 4.40-1. | Orbiter RG SOP Functional Block Diagram..... | 89 |
| 4.41-1. | SRB Rate Gyro SOP Functional Block Diagram | 101 |
| 4.42-1. | AA SOP Functional Block Diagram..... | 109 |
| 4.51-1. | BF SLEW SOP Functional Block Diagram | 116 |
| 4.53-1. | Two-Axis RHC SOP Functional Block Diagram | 129 |
| 4.54-1. | THC SOP Functional Block Diagram | 137 |
| 4.55-1. | SBTC SOP Functional Block Diagram..... | 147 |
| 4.56-1. | RPTA SOP Functional Block Diagram | 159 |
| 4.57-1. | Landing SOP Functional Block Diagram..... | 171 |
| 4.59-1. | Nose Wheel Position SOP Functional Block Diagram..... | 185 |
| 4.59-2 | Position Filter | 187 |
| 4.59-3 | Difference Filter | 188 |

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|--|--------------------|
| 4.59-4.(1) | Nose Wheel Position SOP Flow (Sheet 1 of 3)..... | 191 |
| 4.59-4.(2) | Nose Wheel Position SOP Flow (Sheet 2 of 3)..... | 192 |
| 4.59-4.(3) | Nose Wheel Position SOP Flow (Sheet 3 of 3)..... | 193 |
| 4.171-1. | Three Axis RHC SOP Functional Block Diagram | 207 |
| 4.199-1. | Orbital Three-Axis RHC SOP Functional Block Diagram | 225 |
| 4.216-1. | FC Switch SOP Functional Block Diagram | 239 |
| 5-1. | Structure Flow Chart Legend | 248 |
| 5.39-1.(1) | ADS_CALC Functional Module (OPS 3) (Sheet 1 of 5)..... | 252 |
| 5.39-1.(2) | ADS_CALC Functional Module (OPS 6) (Sheet 2 of 5)..... | 253 |
| 5.39-1.(3) | ADS_CALC Functional Module (OPS 3 and 6) (Sheet 3 of 5)..... | 254 |
| 5.39-1.(4) | ADS_CALC Functional Module (OPS 3 and 6) (Sheet 4 of 5)..... | 255 |
| 5.39-1.(5) | ADS_CALC Functional Module (OPS 3 and 6) (Sheet 5 of 5)..... | 256 |
| 5.39-2. | AOA Common Module | 257 |
| 5.39-3. | SSEC Common Module..... | 258 |
| 5.39-4. | PSEC Common Module..... | 259 |
| 5.39-5. | Mach Common Module | 260 |
| 5.39-6. | PRALT Common Module..... | 261 |
| 5.39-7. | PRALTC Common Module | 262 |
| 5.39-8. | NSATM Common Module..... | 263 |
| 5.39-9. | NSATMH Common Module..... | 264 |
| 5.39-10. | STDATM Common Module | 265 |

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|---|--------------------|
| 5.39-11. | DYPRS Common Module..... | 266 |
| 5.39-12. | EQAS Common Module | 267 |
| 5.39-13. | ETRAS Common Module..... | 268 |
| 5.39-14. | DEFAD Common Module | 269 |
| 5.39-15.(1) | LR_CALC Functional Module (Sheet 1 of 6)..... | 270 |
| 5.39-15.(2) | LR_CALC Functional Module (Sheet 2 of 6)..... | 271 |
| 5.39-15.(3) | LR_CALC Functional Module (Sheet 3 of 6)..... | 272 |
| 5.39-15.(4) | LR_CALC Functional Module (Sheet 4 of 6)..... | 273 |
| 5.39-15.(5) | LR_CALC Functional Module (Sheet 5 of 6)..... | 274 |
| 5.39-15.(6) | LR_CALC Functional Module (Sheet 6 of 6)..... | 275 |
| 5.39-16.(1) | ADS_RM_CALC Functional Module (Sheet 1 of 2)..... | 277 |
| 5.39-16.(2) | ADS_RM_CALC Functional Module (Sheet 2 of 2)..... | 278 |
| 5.39-17. | PARAT Common Module..... | 279 |
| 5.39-18. | STLIM Module | 280 |
| 5.40-1. | ORB_RG_SOP Functional Module..... | 281 |
| 5.40-2. | DATACOMP Common Module..... | 282 |
| 5.41-1. | SRB_RG_COMP Functional Module | 283 |
| 5.42-1. | AA SOP Functional Module | 284 |
| 5.51-1. | BF_SLEW Functional Module..... | 285 |
| 5.53-1. | RHC_SOP Functional Module..... | 286 |
| 5.53-2. | RHC_COMP Functional Module | 287 |

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|--|--------------------|
| 5.53-3.(1) | RHC_DB Functional Module (Sheet 1 of 2)..... | 288 |
| 5.53-3.(2) | RHC_DB Functional Module (Sheet 2 of 2)..... | 289 |
| 5.53-4.(1) | RHC_DOWNMODE Functional Module (Sheet 1 of 2)..... | 290 |
| 5.53-4.(2) | RHC_DOWNMODE Functional Module (Sheet 2 of 2)..... | 291 |
| 5.53-5. | RHC_STA_SEL Functional Module..... | 292 |
| 5.53-6. | Deadband Common Module..... | 293 |
| 5.53-7. | PAN_TRIM Functional Module..... | 294 |
| 5.53-8. | RHC_TRIM Functional Module..... | 295 |
| 5.54-1. | THC_SOP Functional Module..... | 296 |
| 5.54-2. | THC_TRANS Functional Module..... | 297 |
| 5.54-3. | THC_STA_SEL Functional Mode..... | 298 |
| 5.55-1. | SBTC_SOP Functional Module..... | 299 |
| 5.55-2. | SBTC_COMP Functional Module..... | 300 |
| 5.55-3. | SBTC_STA_SEL Functional Module..... | 301 |
| 5.55-4. | SBTC_THROT_PROC Functional Module..... | 302 |
| 5.56-1. | RPTA_SOP Functional Module..... | 303 |
| 5.56-2. | RPTA_COMP Functional Module..... | 304 |
| 5.56-3. | RPTA_STA_SEL Functional Module..... | 305 |
| 5.56-4. | RPTA_DB Functional Module..... | 306 |
| 5.56-5. | YAW_TRIM Functional Module..... | 307 |
| 5.57-1. | LANDING_SOP Functional Module..... | 308 |

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|--|--------------------|
| 5.57-2. | GEAR_PROC Common Module..... | 309 |
| 5.171-1. | 3 AX_RHC SOP Functional Module..... | 310 |
| 5.171-2. | 3 AX_COMP Functional Module..... | 311 |
| 5.171-3. | 3 AX_VALID Functional Module..... | 312 |
| 5.171-4. | 3 AX_DB Functional Module | 313 |
| 5.171-5. | 3 AX_STA_SEL Functional Module..... | 314 |
| 5.171-6. | 3 AX_DETENT Functional Module..... | 315 |
| 5.171-7. | INT_STA_SEL Functional Module | 316 |
| 5.171-8. | 3 AX_SOFTSTOP Functional Module..... | 317 |
| 5.171-9. | DISC_STA_SEL Functional Module | 318 |
| 5.171-10. | HYSTER_1 Common Module | 319 |
| 5.171-11. | HYSTER_2 Common Module | 320 |
| 5.199-1. | ORB_3AX_RHC_SOP Functional Module..... | 321 |
| 5.199-2. | ORB_3_COMP Functional Module | 322 |
| 5.199-3. | ORB_3_VALID Functional Module..... | 323 |
| 5.199-4. | ORB_3DB Functional Module..... | 324 |
| 5.199-5. | RHC_SCALAR_TRANS Functional Module | 325 |
| 5.199-6. | ORB_3_STA_SEL Functional Module | 326 |
| 5.199-7. | ORB_3_DETENT Functional Module | 327 |
| 5.199-8. | RHC_INT_TRANS Functional Module..... | 328 |
| 5.199-9. | ORB_INT_STA_SEL Functional Module..... | 329 |

List of Figures

| <u>FIGURE</u> | <u>TITLE</u> | <u>PAGE</u> |
|----------------------|--|--------------------|
| 5.199-10. | ORB_3_SOFTSTOP Functional Module | 330 |
| 5.199-11. | RHC_DISC_TRANS Functional Module..... | 331 |
| 5.199-12. | ORB_DISC_STA_SEL Functional Module | 332 |
| 5.216-1. | FC_SWIT_SOP Functional Module..... | 333 |
| 5.216-2. | DAP_TRANS_STASEL Functional Module..... | 334 |
| 5.216-3. | ROT_SW_TRANS Functional Module..... | 335 |
| 5.216-4. | ROT_SW_STASEL Functional Module | 336 |
| 5.216-5. | ROT_LAMP_CMD Functional Module..... | 337 |

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of the Subsystem Operating Program (SOP) Level C document is to specify the requirement details of the SOP Level B functional requirements for the Orbiter GN&C flight software.

1.2 SCOPE

This document is one of four documents which contain the requirement details for those SOP functions which are necessary during the Shuttle operations. The SOP functions are those specified in the GN&C Level B functional requirements document. This particular document addresses the Flight Control Sensor/Controller SOP's.

1.3 ORGANIZATION

This document is organized into the following sections:

- 1.0 INTRODUCTION
- 2.0 APPLICABLE DOCUMENTS
- 3.0 OVERVIEW
- 4.0 DETAIL LEVEL REQUIREMENTS
- 5.0 FORMULATIONS
- 6.0 GLOSSARY

Section 1 defines the purpose, scope and organization of this document. Section 2 lists the applicable documents. Section 3 provides an overview of the Shuttle software functions and discusses the contents of Section 4. Section 4 specifies the requirement details of the functional requirements for each Subsystem Operating Program. It also contains applicable tables (Interface Definition Document (IDD) inputs/outputs, I-Loads, K-Loads, and Constants) located at the end of each Principal Function. Section 5 shows a formulation of the detailed requirements. Lastly, Section 6 contains a list of definitions and a list of acronyms and abbreviations.

The automated IDD tables provided herein define signal (parameter) interface requirements either between hardware (LRU) and software elements or between software elements and other software elements. A GN&C software element is either a sequenced principal function (PF), crew generated specialist/display function, or an OPS display function. In the event of a conflict between the IDD tables and other internal text input/output tables, the SASCB data base-controlled IDD tables take precedence.

The following table defines the data elements found in the IDD input/output, I-Load, K-Load, and Constant tables for each principal function.

| Table 1.3-1. Parameter Element Description | | |
|--|--|--|
| Title | Definition | Valid Entries |
| CAT | Category of the I-Load (**Note) | Three alphanumeric characters: the first character must be alphabetic. |
| D | Dependency of the I-Load | D = Design M = Mission L = LRU |
| DESCRIPTION | Parameter description of the K-Load or Constant. | A string of ≤ 64 characters. |
| DESTINATION | Destination of the output parameter | Abbreviated functional titles. (***)Note) |
| DT or DATA TYPE | Data Type | * See reference (1) for valid I-Load, K-Load and Constant data types. * See reference (2) for valid IDD data types for parameters with destination TLM. * See reference (3) for valid IDD data types for all other parameters. |
| ENG UNITS or UNITS | Engineering Units | * See reference (1) for valid I-Load, K-Load and Constant units. * See reference (2) for valid IDD units for parameters with destination TLM. * See reference (3) for valid IDD units for all other parameters. |
| FSSR NAME | Requirements parameter name | A string (with no embedded blanks) of ≤ 32 characters consisting of alphanumerics, underscores, parenthesis, commas and slashes. Parenthesis are used for array elements. Commas separate the different indices of multidimensional arrays. Slashes are used to separate multiple names used for a single MSID. |
| LAST CR | The last CR affecting the parameter | 5 digit number with an alphabetic revision letter. |
| MC | Memory Configuration | 00=Generic 05 = SM4 Orbit P/L 01=GN1 Ascent/GN6 RTLS 06 = P/L9 MMU 02=GN2 Orbit 07 = Not Assigned 03=GN3 Entry 08 = GN8 On-Orbit C/O 04=SM2 On-Orbit 09 = GN9 Preflight |
| MSID or M/S ID | Measurement/Stimulus Identification | Maximum of 10 alphanumeric characters. * See reference (3) for specifications |
| NOMENCLATURE | Parameter description of the IDD parameter. | String of ≤ 34 characters (including underscores and blank spaces). |
| PR or PREC | Precision | D, DP =Double S, SP =Single |
| SOURCE | Origin of the input parameter | Abbreviated functional titles. |

| Table 1.3-1. Parameter Element Description | | |
|--|--|---|
| Title | Definition | Valid Entries |
| S | Software Utilization | C = Common B = BFS Unique P = Primary X = BFS Derived A = BFS Converted |
| PR FCTN | Cross reference of the principal function identifiers that are applicable to this parameter. | See Level B GN&C CPDS SS-P-0002-510 |
| VALUE | The value of the K-Load or Constant | * See reference (1) for valid value formats. |
| REV | Revision indicator | An Asterisk (*) indicates changes for the current OI version. |
| <p>* References: (1) JSC 19350 I-Load Requirements Document Volume I (2) SS-P-0002-140 Level A SS Downlist/Uplink CPDS (3) JSC 18206 Shuttle Data Integration Plan Volume III MAST II/STAR Deliverable Products.</p> <p>** Note For additional information on any I-Load, contact the I-Load owner defined in CR 98032, JSC, USA, and Boeing I-Load Owner Assignments</p> <p>*** Note IDD output (source) tables which reflect parameters going to input (destination) "TLM" shall not be interpreted as a signal actually being downlisted. The parameter is only available for downlist in COMPOOL and does not appear in a downlist format. Parameters actually on the downlist will be designated with a destination denoting the downlist Format with a Rate Code. The Rate Code legend appears at the end of each FSSR data table. To complete the downlist information, Parent MSIDs (indicated by a 'P' in the 9th character of the MSID) are now included in the software function output data tables in which a Child MSID already appears. A Parent MSID will have the same downlist destinations as its Child(ren) MSID(s).</p> | | |

This page intentionally left blank.

2.0 APPLICABLE DOCUMENTS

2.1 LEVEL A DOCUMENTS

- SS-P-0002-140 Downlist/Uplink Software Requirements
- SS-P-0002-150 Shuttle Launch Data Bus Software Interface Requirements
- SS-P-0002-170 Shuttle System Level Requirements, Software

2.2 LEVEL B DOCUMENTS

- SS-P-0002-510 Shuttle Functional Level Requirements, GN&C
- SS-P-0002-550 Shuttle Functional Level Requirements, Vehicle Utility
- SS-P-0002-580 Shuttle Functional Level Requirements, Systems Management

2.3 LEVEL C DOCUMENTS

- STS 83-0001 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part A, Entry Through Landing Guidance
- STS 83-0002 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part A, Guidance Ascent/RTL
- STS 83-0003 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part A, Guidance On-Orbit/Deorbit
- STS 83-0004 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part B, Entry Through Landing Navigation
- STS 83-0005 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part B, Navigation Ascent/RTL
- STS 83-0006 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control Part B, On-Orbit Navigation
- STS 83-0007 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part C, Flight Control Entry – GRTL
- STS 83-0008 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part C, Flight Control Volume 1, Ascent Flight Phase, Volume 2, Ascent
- STS 83-0009 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part C, Flight Control Orbit DAP
- STS 83-0010 Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part D, Redundancy Management

STS 83-0015-34
December 14, 2007

| | |
|-------------|---|
| STS 83-0013 | Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part E, Inertial Measurement Unit Subsystem Operating Program |
| STS 83-0014 | Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part E, Volume 1, Navigation Aids Subsystem Operating Program, Volume 2, Star Tracker Subsystem Operating Program |
| STS 83-0015 | Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part E, Subsystem Operating Programs, FC Sensor/Controller |
| STS 83-0016 | Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Part E, Subsystem Operating Programs, FC Effector |
| STS 87-0017 | Operational Flight Level C, Functional Subsystem Software Requirements; Remote Manipulator System |
| STS 83-0020 | Operational Flight Level C, Functional Subsystem Software Requirements; Displays and Controls |
| STS 83-0026 | Operational Flight Level C, Functional Subsystem Software Requirements; Guidance, Navigation and Control, Sequencing |
| JSC-19350 | Shuttle Flight Software Initialization Load, <ul style="list-style-type: none">• Volume I General Requirements• Volume II Mission I-Load Requirements |
| JSC-19478 | Payload Management, Level C Flight Software Requirements |
| JSC-19590 | Systems Management, Level C Flight Software Requirements |

2.4 ICD DOCUMENTS

| | |
|---------------|--|
| ICD 3-1011-02 | OFT GPC/DEU ICD |
| ICD 2-1S001 | Orbiter Primary Flight Software System and Backup Flight System Software Interface |

3.0 OVERVIEW

3.1 SHUTTLE OPERATIONAL PROGRAM

The Shuttle operational program represents the total computer program which operates in the orbiter general purpose flight computer for the Shuttle operations. The requirements are specified at three levels:

- Level “A” – System Level Constraints and Capabilities
- Level “B” – Functional Requirements
- Level “C” – Detail Level Requirements

The Level A specifies system level constraints and capabilities which are not oriented toward any particular program end item. Levels B and C specify the functional and detailed level requirements and are program end item oriented. The Level B requirements are specified in four separate documents for Guidance, Navigation and Control (GN&C), Systems Management (SM), Vehicle Utility (VU), and Payloads.

3.2 GN&C SOFTWARE REQUIREMENTS STRUCTURE

This section describes the top level GN&C software requirements structure for purposes of specifying the functional requirements for operations. The structure is described below:

- A. Operational Sequence – A collection of sequentially ordered major modes and a group of specialist and display functions.
- B. Major Modes – A collection of principal functions and display formats scheduled automatically or upon crew request.
- C. Function – A task to be performed by the software. Functions are defined as:
 1. Principal function – A function that can only be initiated by the software. Principal functions may be ordered sequentially, run in parallel, enabled or inhibited.
 2. Specialist function – A task that is scheduled upon crew command.
 3. Display function – A presentation to the crew of parameters that are already being computed.

The principal and specialist functions are only available during specific major modes. Each principal and specialist function can be classified into one of the following GN&C major functions:

- Guidance
- Navigation
- Flight Control
- Redundancy Management
- Subsystem Operating Programs
- Displays and Controls

This document documents a portion of the SOP principal functions related to flight control sensors and controllers and includes the following:

- Air Data Transducer Assembly SOP
- Orbiter Rate Gyro SOP
- SRB Rate Gyro SOP
- Accelerometer Assembly SOP
- Body Flap Slew Command SOP
- 2–Axis Rotational Hand Controller SOP
- 3–Axis Rotational Hand Controller SOP
- Orbit 3–Axis Rotational Hand Controller SOP
- Translational Hand Controller SOP
- Speed Brake Thrust Controller SOP
- Rudder Pedal Transducer Assembly SOP
- Landing SOP
- Nose Wheel Position SOP
- Flight Control Switch SOP

3.3 SOP OVERVIEW

The SOPs basically provide services and interfaces between the GN&C Line Replacable Units (LRUs) and other application programs. The nature of the services and interfaces provided is indicated by the general SOP functions described below:

- A. Format conversion to support input/output processing;
- B. Data compensation to convert data into engineering units by applying biases and scale factors;
- C. Data transformations and special computations as required by other application programs;
- D. Generation of appropriate data and interfaces to Display and Control (D&C);
- E. BITE and failure discrete monitoring and reporting of status to Redundancy Management (RM) for further processing; and
- F. Moding, sequencing and control at the individual SOP level.

In some cases, such as that of the IMU, the SOPs perform alignment, calibration and preliminary data calculations. The SOPs do not include the specific input/output services provided by FCOS, nor do they include the data selection and failure management functions performed by other application programs.

3.4 SOP SUBSECTION ORGANIZATION

Section 4 of this document contains the SOP requirement details. Each subsection in Section 4 is dedicated to a particular SOP and corresponds to a subsection of the GN&C Level B CPDS to provide one-to-one traceability. To further assist in traceability, the Level B paragraph numbers are also used in the corresponding Section 4 paragraphs of this document. The contents of the paragraphs for a typical SOP subsection include:

- A. The purpose(s) of the SOP.
- B. The detailed requirements including pertinent equations, necessary logic, assumptions made, constraints and definition of coordinate systems. The level of detail specified is sufficient to generate computer code.
- C. Interface Parameters – Those parameters required to properly execute the particular SOP are discussed in detail. The interface details are tabulated and are placed at the end of each SOP section. The tabulated information consists of the following:
 1. Parameter name – A unique name is assigned to each parameter. Elements of an array are denoted by numbers in parentheses. This name is used throughout the formulation.
 2. Measurement/Stimuli Identifier (MSID) number – The first set of numbers (basic nine characters (x99x9999x)) listed represent measurement and stimuli numbers in the Measurement And Stimuli (MAST II) and Space Transportation Automated Reconfiguration (STAR) databases as defined in the Shuttle Data Integration Plan (DIP) (JSC-18206). For any discrepancies, the MAST II or STAR database has precedence.
 3. Description – A brief description of the parameter is provided by this column. If the parameter is a Shuttle Master Measurement List (MML) (MAST II DIP product) parameter, the description provided is very similar, if not identical, to that provided in the MML.
 4. Input source – The input source is specified as either a hardware LRU or a software function.
 5. Output destination – The output destination is specified as either a hardware LRU or a software function.

6. Type – The parameter types are:
 - a. Fixed point – A signed binary number in which the fixed location of the binary point is assumed.
 - b. Floating point – A signed decimal number in which provisions are made for varying the location of the decimal point.
 - c. Integer – A signed whole number.
 - d. Discrete – A two–state variable.
7. Range – The limits over which the parameter is expected to vary. Values in parentheses indicate equivalent engineering units.
8. Units – The parameter’s standard of measurement.
9. Rate – The input sampling rate or the rate of output generation is specified in Hertz.

D. The parameters which require initialization and their values are specified. This does not include initialization processing which requires execution. This information is provided in tables which consist of the following:

1. Parameter name – A unique name is assigned to each parameter. Elements of an array are denoted by numbers in parentheses.
2. MSID number – The number listed represents the measurement or stimuli number provided in the MML.
3. Description – A brief description of the parameter is provided.
4. Constant type – If the parameter requiring initialization is an I–load constant, this column contains the following identification:
 - a. M – Mission Dependent parameters are those that change because of trajectory (orbital inclination, flight path, and glideslope), mission techniques (speed brake profile, abort sequences), mass properties, and time.
 - b. L – LRU Dependent parameters are those that are a function of a black box (biases, scale factors, breakout switches, etc.).
 - c. D – Design Dependent parameters are those for which analyses or simulations must be completed before the final value can be determined (flight control gains, filter coefficients, L/D related parameters).
 - d. K – Fixed Constants that have specific values and all functions requiring these parameters should use the same value.
 - e. R – Remove from I–load. Hard code.

5. Type – The parameter types are:
 - a. Fixed point – A signed binary number in which the fixed location of the binary point is assumed.
 - b. Floating point – A signed decimal number in which provisions are made for varying the location of the decimal point.
 - c. Integer – A signed whole number.
 - d. Discrete – A two–state variable generated by the GN&C subsystems.
6. Value – The initial value of the parameter.
7. Range – The limits over which the parameter is expected to vary.
8. Units – The parameter’s standard of measurement.

E. Execution rates – The execution rate of each SOP subfunction is specified in Hertz.

Subparagraphs are generally used to verify the detailed requirements of subfunctions. For each SOP, the organization of the subparagraphs is tailored to individual needs and peculiarities. The major modes in which each SOP is executed are specified in GN&C Level B CPDS SS–P–0002–510 as well as in the individual SOP. The detailed sequencing requirements, if any, are specified within the individual SOP. Single precision is required for all floating point parameters and computations unless specified otherwise.

This document does not address the MDM channelization (i.e., the specific MDM address, input/output module, and channel/bit assignments) of external input/output signals. The channelization of these signals is specified in the MAST II database system.

3.5 IMPLEMENTATION CONSTRAINTS

The SOPs are capable of recovering from the effects of many transient–type errors. Accordingly, the software design shall not preclude this capability by causing a program halt, permanent discontinuance of SOP processing or loss of protected data as a result of program check or error interrupts.

Wherever potential transient–type errors have been identified, software requirements for limit checks, etc., and appropriate action have been defined in Section 4 detailed requirements. In addition, any other check or error interrupts shall be prevented by software safeguards; or standard fix–up and error returns shall be accomplished as described in Level A CPDS SS–P–00020170 Section 4.6.4.

3.6 TIMING

Timing in this document is related to error–free processing conditions. See Level A CPDS SS–P–0002–170, paragraph 4.4.2A, for timing related to error processing conditions.

This page intentionally left blank.

4.0 DETAIL LEVEL REQUIREMENTS

The Subsystem Operating Programs (SOPs) specify the software required for operation of the GN&C subsystem hardware external to the Data Processing Subsystem (DPS).

The SOPs provide necessary services and interfaces between the GN&C Line Replaceable Units (LRUs) and other application programs. The major SOP functions are format conversion, data compensation, moding and sequencing, BITE monitoring and special computations. The SOPs do not include the specific input/output services provided by FCOS, nor do they include the data selection and failure management functions performed by other application programs.

This section specifies the detailed requirements for the Flight Control Sensor/Controller SOPs which are organized as follows:

| Section | Title |
|---------|-------------------------|
| 4.39 | Air Data SOP |
| 4.40 | Orbiter RG SOP |
| 4.41 | SRB RG SOP |
| 4.42 | AA SOP |
| 4.51 | BF Slew CMD SOP |
| 4.53 | 2–Axis RHC SOP |
| 4.54 | THC SOP |
| 4.55 | SBTC SOP |
| 4.56 | RPTA SOP |
| 4.57 | Landing SOP |
| 4.59 | Nose Wheel Position SOP |
| 4.171 | 3–Axis RHC SOP |
| 4.199 | Orbit 3–Axis RHC SOP |
| 4.216 | FC Switch SOP |

Section 4.0.1 contains Table 4.0.1–1 which provides the major mode in which a principal function is operational, and the highest processing rate of that principal function in each major mode.

Section 4.0.2 contains Table 4.0.2–1, which provides the traceability of the software segments in the FSSR Level C with respect to the Level B CPDS.

Each principal function provides tables taken directly from the Rockwell International GN&C Interface Definition Document (IDD).

The SOP I–load constants, as defined earlier, are listed in tables at the end of each principal function. These tables centralize the I–load constants documented elsewhere in the various principal function sections. These tables are organized on a SOP basis.

4.0.1 Flight Control Effector SOP

Table 4.0.1-1 lists the major modes and rates.

| Table 4.0.1-1. Sensor/Controller SOP Operational Major Modes/Rates | | | | | | | | | | | | | | | | |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Principal Function | 101 | 102 | 103 | 104 | 105 | 106 | 201 | 202 | 301 | 302 | 303 | 304 | 305 | 601 | 602 | 603 |
| 4.39 ADTA SOP | | | | | | | | | | | | 1.04 | 1.04 | | 1.04 | 1.04 |
| 4.40 ORB RG SOP | 25.0 | 25.0 | 25.0 | 12.5 | 12.5 | 12.5 | | | 12.5 | 12.5 | 12.5 | 25.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| 4.41 SRB RG SOP | 25.0 | 25.0 | | | | | | | | | | | | | | |
| 4.42 AA SOP | 25.0 | 25.0 | | | | | | | 0.52 | 0.52 | 0.52 | 25.0 | 25.0 | | 25.0 | 25.0 |
| 4.51 BF SLEW SOP | | | | | | | | | | | | 6.25 | 6.25 | | 6.25 | 6.25 |
| 4.53 2-AX RHC SOP | | | | | | | | | | | | 25.0 | 25.0 | | 25.0 | 25.0 |
| 4.54 THC SOP | | | | | | | 6.25 | 6.25 | | | | | | | | |
| 4.55 SBTC SOP | | 6.25 | 6.25 | | | | | | | | | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 |
| 4.56 RPTA | | | | | | | | | | | | 6.25 | 6.25 | | 6.25 | 6.25 |
| 4.57 LANDING SOP | | | | | | | | | | | | | 6.25 | | | 6.25 |
| * | | * | * | | | | | | | | | | | * | | |
| 4.59 NW POSN SOP | | | | | | | | | | | | | 25.0 | | | 25.0 |
| 4.171 3-AX RHC SOP | | 12.5 | 12.5 | 12.5 | 12.5 | 12.5 | | | 12.5 | 12.5 | 12.5 | | | 12.5 | | |
| 4.199 ORB 3-AX RHC SOP | | | | | | | 12.5 | 12.5 | | | | | | | | |
| 4.216 FC SWIT PROC | | | | | | | 12.5 | 12.5 | | | | | | | | |
| *ON DEMAND | | | | | | | | | | | | | | | | |

4.0.2 Traceability

Table 4.0.2-1 shows the traceability of the software paragraphs in this FSSR with respect to the corresponding Sections of the Level B CPDS' documentation. In addition, Table 4.0.2-2 shows the traceability of the PASS GN&C principal functions located in this FSSR with respect to the applicable BFS paragraphs in the Level C PRD specifications. These tables are provided for information only.

| Table 4.0.2-1. Functional/Document Traceability | | |
|---|---|-----------------------------|
| Level B PF Number | Level B PF Name (Acronym) | Level C FSSR Section No. |
| 4.42 | Accelerometer Assembly (AA) SOP (AA SOP) | 4.42 |
| 4.39 | Air Data Transducer Assembly (ADTA) SOP (ADTA SOP) | 4.39 |
| 4.51 | Body Flap (BF) Slew Command SOP (BF SLEW SOP) | 4.51 |
| 4.216 | Flight Control (FC Switch SOP (FC SWIT PROC) | 4.216 |
| 4.57 | Landing SOP (LANDING SOP) | 4.57 |
| 4.59 | Nose Wheel (NW) Position SOP (NW POSN SOP) | 4.59 |
| 4.40 | Orbiter Rate Gyro (RGA) SOP (ORB RG SOP) | 4.40 |
| 4.199 | Orbital Three-Axis Rotational Hand Controller (RHC) SOP (ORB 3-AX RHC SOP) | 4.199 |
| 4.56 | Rudder Pedal Transducer Assembly (RPTA) SOP (RPTA SOP) | 4.56 |
| 4.55 | Speed Brake Thrust Controller (SBTC) SOP (SBTC SOP) | 4.55 |
| 4.41 | Solid Rocket Booster (SRB) Rate Gyro (RG) SOP (SRB RG SOP) | 4.41 |
| 4.171 | Three-Axis Rotational Hand Controller (RHC) SOP (3-AX RHC SOP) | 4.171 |
| 4.54 | Translation Hand Controller (THC) SOP (THC SOP) | 4.54 |
| 4.53 | Two-Axis Rotational Hand Controller (RHC) SOP (2-AX RHC SOP) | 4.53 |

| Table 4.0.2-2.Sensor/Controller SOP FSSR/PRD Correlation | | | | | |
|--|----------------|---|----------|---------------|--|
| Principal Function | FSSR Paragraph | FSSR Title | BFS PRD | PRD Paragraph | BFS Title |
| G4.39 | 4.39 | ADTA SOP | MG038106 | 3.2.5.2.1 | Air Data Transducer Assembly Hardware Interface Program (ADTA_HIP) |
| G4.40 | 4.40 | Orbiter Rate Gyro SOP | MG038106 | 3.2.5.3.1 | Orbiter Rate Gyro Assembly (ORB_RG_HIP) |
| G4.41 | 4.41 | SRB Rate Gyro SOP | MG038106 | 3.2.5.3.2 | SRB Rate Gyro Assembly (SRB_RG_HIP) |
| G4.42 | 4.42 | Accelerometer Assembly SOP | MG038106 | 3.2.5.3.3 | Accelerometer Assembly (AA_HIP) |
| G4.51 | 4.51 | Body Flap Slew Command SOP | MG038106 | 3.2.5.4.10 | Body Flap Slew PROC |
| G4.53 | 4.53 | Two-Axis Rotational Hand Controller SOP | MG038106 | 3.2.5.4.6 | Rotational Hand Controller HIP (RHC_HIP) |
| G4.54 | 4.54 | Translation Hand Controller SOP | MG038106 | 3.2.5.6.1 | GNC_SW_HIP |
| G4.55 | 4.55 | Speed Brake Thrust Controller SOP | MG038106 | 3.2.5.4.8 | Speed Brake Thrust Controller (SBTC_HIP) |
| G4.56 | 4.56 | Rudder Pedal Transducer Assembly SOP | MG038106 | 3.2.5.4.9 | Rudder Pedal Transducer Assembly HIP |
| G4.57 | 4.57 | Landing SOP | MG038106 | 3.2.5.6.3 | (LANDING_HIP) |
| G4.59 | 4.59 | Nose Wheel Position SOP | MG038106 | 3.2.5.4.18 | Nose Wheel Position Feedback HIP |
| G4.171 | 4.171 | Three-Axis Rotational Hand Controller SOP | MG038106 | 3.2.5.4.6 | Rotational Hand Controller HIP (RHC_HIP) |
| G4.199 | 4.199 | Orbital Three-Axis Rotational Hand Controller SOP | N/A | N/A | N/A |
| G4.216 | 4.216 | Flight Control Switch SOP | MG038106 | 3.2.5.6 | Input HIP's (Switch) |

4.0.3 Documented Requirements Precedence

Requirements precedence in this document shall be as follows:

1. If there is a conflict between the data in the function subtables and the standard principal function tables, the principal function tables shall have precedence.
2. If there is a conflict between the data in the flow diagrams and the written requirements, the written requirements shall have precedence.

4.39 AIR DATA TRANSDUCER ASSEMBLY SOP

This section documents the detail level requirements for the ADTA SOP principal function.

4.39.1 Overview

The purpose of the ADTA SOP is to provide the following functions:

- A. Calculation of the following Air Data Subsystem (ADS) air data parameters for GN&C:
 1. Angle of attack,
 2. Mach number,
 3. Corrected pressure altitude,
 4. Dynamic pressure,
 5. Equivalent airspeed, and
 6. True airspeed.
- B. Transitioning between Nav-derived, ADS, and default air data parameters.
- C. Calculation and transitioning of the following left/right side air data parameters for dedicated displays:
 1. Angle of attack,
 2. Mach number,
 3. Equivalent airspeed,
 4. Corrected pressure altitude, and
 5. Pressure altitude rate.
- D. Calculation of individual ADTA air data parameters for redundancy management display.

The ADS air data parameters refer to those parameters which are calculated based on the center selection filter outputs (usually reflects the average of the left and right selected ADTA values). Calculation of ADS air data parameters is initiated whenever at least one probe is deployed and good ADTA data is present. The ADS calculations require about four computational cycles to converge to steady-state values.

OPS 6 Automatic ADS/NAVDAD Switch by Altitude

If, during a contingency abort (OPS 6), the Corrected Pressure Altitude (HPC) in the ADS calculations has been limited at the upper limit of its range KHPC₃, then automatically switch from ADS to NAVDAD for all Air Data parameter outputs to G&C. While in NAVDAD, during contingency abort, moding to DEFAULT Air Data will be inhibited. Switch back to ADS when HPC is no longer limited at its upper limit. In addition, the altitude output to navigation will be invalid while HPC exceeds its upper limit. Left/Right dedicated display outputs are unaffected by the change.

Transition from navigation-derived air data (NAVDAD) to ADS air data is performed via the Horizontal Situation Display Principal Function which is initialized to the inhibited mode (INH). The automatic transition occurs when either or both probes are deployed and no data transients or dilemma conditions exist and when certain velocity limits have been achieved. Once the velocity limit has been achieved, this check should be bypassed or latched, thus preventing subsequent velocity “glitches” from transitioning

from ADS back to NAVDAD while in auto transition. In OPS 6 only, an additional test is made before automatically transitioning to ADS from NAVDAD. If, in a contingency abort, the corrected pressure altitude (HPC) in the ADS calculations has been limited at the upper end of its range ($KHPC_3$), then the vehicle is above the region of air data calibration, and Air Data system outputs are assumed to have degraded. While this excess altitude condition is true, the ADS Air Data are automatically downmoded to NAVDAD, and the altitude output to navigation is made invalid. Subsequently, the crew may inhibit ADS air data and recall NAVDAD (via the keyboard entry (INH)) or (with the keyboard entry (FOR)) force ADS air data in lieu of NAVDAD. In the event of an RM dilemma condition (after transition) in either the AUTO or FORCE States, the ADS air data are automatically downmoded to a pre-selected set of default parameters which permits time for the crew to resolve the dilemma if they so desire. Angle of attack transitions from ADS to NAV-DERIVED while the ADS value exceeds its upper limit. In OPS 6 only, automatic transition from NAVDAD to default parameters is inhibited for contingency abort.

Whenever either air data source select switch is in the “NAV” position, the air data parameters displayed on the AMI dedicated display reflect whatever air data parameters (nav-derived or ADS) are being used by GN&C. The AVVI dedicated display, however, always reflects NAVDAD. In the event of a default condition, NAVDAD is displayed on both dedicated displays. The left and right side calculations are initiated whenever either air data source select switch is in the “LEFT” or “RIGHT” position. Whenever the E_PROBE_DEPLOY flag is set true, the outputs of all four ADTAs are used to compute altitude, Mach number, and angle of attack which are displayed on the OVERRIDE SPEC. Figure 4.39-1 illustrates a functional block diagram of the ADTA SOP functions and interfaces.

The air data calculation functions are executed to provide the air data parameters at the rate shown on Table 4.39.1-1.

The equations for the air data calculations are presented in both closed and polynomial forms wherever applicable. It is left to the software contractor to determine which form to implement. The actual choice should be made on computer resource and accuracy considerations. The closed form equations have been chosen to provide an identical set of interface parameters as those required for the polynomial equations. Although the nested form of the polynomial equations is recognized as being more efficient, the polynomial equations are presented as a power series for clarity. The use of single or double precision is left to the discretion of the software contractor. The air data calculations are valid for portions of Major Modes 304, 305, 602, and 603. The air data calibration data is not accurate during rollout but has been included for crew convenience in assessing equivalent airspeed during the slowdown period.

| Table 4.39.1-1. Air Data Parameter Execution Rates | | | |
|--|---------------------|-----------------|-----------|
| Air Data Parameter | Execution Rate (Hz) | | RM Calc's |
| | ADS Calc's | L/R Side Calc's | |
| Angle of Attack | 1.04 | 1.04 | 0.5 |
| Mach Number | 1.04 | 1.04 | 0.5 |
| Corrected Pressure Altitude | 1.04 | 1.04 | 0.5* |
| Dynamic Pressure | 1.04 | – | – |
| Equivalent Airspeed | 1.04 | 1.04 | – |
| True Airspeed | 1.04 | – | – |
| Pressure Altitude Rate | – | 1.04 | – |
| *Uncorrected Pressure Altitude | | | |

4.39.2 ADTA SOP Detail Level Requirements

The ADTA SOP shall perform the following functions:

- A. Calculation of ADS air data parameters for GN&C;
- B. Transition of Nav-derived, ADS, and default air data;
- C. Calculation and transition of left and right air data parameters for crew display; and
- D. Calculation of individual ADTA air data parameters for redundancy management displays.

These functions are discussed in the following subparagraphs. The initialization requirements are presented in Table 4.39-1. The IDD inputs and outputs are listed in Tables 4.39-2 and 4.39-3. Values for the I-loads are contained in the I-loads requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.39-4. K-loads are listed in Table 4.39-5. Constants are listed in Table 4.39-6. All initialization parameters which indicate a type “2B” are likely to change from mission to mission and are therefore considered mission dependent.

4.39.2.1 ADS Air Data Calculations.

The purpose of the ADS air data calculation function shall be to initiate calculation of the ADS air data parameters. This function shall be executed after RM center selection filter processing and prior to the NAV/ADS/DEFAULT air data transition function of Paragraph 4.39.2.2. The execution rates of this function shall provide the ADS air data parameters at the following rates:

- Angle of attack 1.04 Hz
- Corrected pressure altitude 1.04 Hz
- Mach number 1.04 Hz
- Dynamic pressure 1.04 Hz
- Equivalent airspeed, and 1.04 Hz
- True airspeed 1.04 Hz

The ADS air data calculation function shall be automatically performed when either or both the left or right probe has deployed.

No initialization processing for data convergence or other validity flags shall be required. The first initialization period occurs after probe deployment and is approximately 4 seconds in duration. During this period the iterative calculations are converging towards the proper values. It is left to crew procedures to select other air data sources via the Horizontal Situation SPEC function.

Re-initialization is required for the ADTA RM dilemma case if the crew switches from default (or NAVDAD) air data back to ADS air data. In the dilemma case, ADTA RM will declare the dilemma; and crew intervention via the OVERRIDE specification function will be required to resolve this condition.

In the short data bad periods (transients) during which no ADS calculations are performed, validity flags to G&C and subsequent user actions during the invalid periods are not required. Note, however, that navigation validity flags will be issued in the region where the probe(s) go sonic (Mach jump region) and whenever a pressure transient or dilemma condition exists.

This function sequentially invokes other subfunctions to calculate the ADS air data parameters. The lower level subfunctions are discussed in subsequent paragraphs and are summarized below:

| Para No. | Subfunction Name | Description | Rate (Hz) |
|-------------|------------------|---|-----------|
| 4.39.2.1.1 | AOA | Angle of attack | 1.04 |
| 4.39.2.1.2 | SSEC | Static source error correction | 1.04 |
| 4.39.2.1.3 | PSEC | Pitot source error correction | 1.04 |
| 4.39.2.1.4 | MACH | Mach Number | 1.04 |
| 4.39.2.1.5 | PRALT | Pressure altitude (UNCORRECTED) | 1.04 |
| 4.39.2.1.6 | PRALTC | Pressure altitude correction | 1.04 |
| 4.39.2.1.7 | MSATM | Non-Standard atmosphere correction for Temp | 1.04 |
| 4.39.2.1.8 | NSATMH | Non-Standard atmosphere correction for Altitude | 1.04 |
| 4.39.2.1.9 | STDATM | U.S. Standard atmosphere 1962 model | 1.04 |
| 4.39.2.1.10 | DYPRS | Dynamic pressure | 1.04 |
| 4.39.2.1.11 | EQAS | Equivalent airspeed | 1.04 |
| 4.39.2.1.12 | ETRAS | Estimated true airspeed | 1.04 |
| 4.39.2.1.13 | DEFAD | Default air data parameters | 1.04 |
| 4.39.2.1.14 | STLIM | Static pressure limiter | 1.04 |

Functional block diagrams depicting the relationships between the above subfunctions are illustrated in Figure 4.39-2 (OPS 3) and Figure 4.39-3 (OPS 6). The above subfunctions are also utilized to calculate air data parameters in L/R_CALCS for dedicated displays and in ADTA_RM_CALCS for CRT display.

A formulation of the ADS_CALC Functional Module is shown in Figure 5.39-1.

4.39.2.1.1 Angle of Attack (AOA).

The purpose of the AOA module is to calculate the angle of attack based on Mach number and the three angle of attack pressures. This module is required for the ADS, left/right side, and ADTA RM air data calculations at the 1.04 Hz rate (0.5 Hz for the ADTA RM calculations). Alpha (V95H3021C) is initialized to the value listed in Table 4.39-1.

The functions to be performed by the AOA module are:

A. Determine Mach Range Index – A Mach range index is to be initially determined by comparing the current value of Mach to the Mach boundaries as follows:

$$\text{If } MB_AOA_I \leq M \leq MB_AOA_{I+1},$$

$$\text{then } M_INDEX = I,$$

where

I = 1,2,3,4,5,6,7,8,9,10,

MB_AOA_I = Mach boundary No. I (n.d.),

M = Current Mach No. (n.d.) from the appropriate source, and

M_INDEX = Mach Range Index (n.d.).

Separate Mach range indexes are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The indexes are used below.

B. Determine Mach Ratio – A Mach ratio is then to be computed based on the current Mach number and Mach boundaries as follows:

$$M_RATIO = \frac{(M - MB_AOA_I)}{(MB_AOA_{I+1} - MB_AOA_I)},$$

where

M_RATIO = Mach ratio (n.d.).

Separate Mach ratios are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The ratios are used below.

C. Determine Alpha Pressure Ratio – An alpha pressure ratio is then to be computed as follows:

$$R = \frac{(PAL - PAU)}{(PAC - 0.5 (PAL + PAU))},$$

where

R = Alpha pressure ratio (n.d.),

PAL = Lower alpha pressure (in.-Hg),

PAU = Upper alpha pressure (in.-Hg), and

PAC = Center alpha pressure (in.-Hg).

If the absolute value of the denominator of the expression for R is less than or equal to KDR, R shall not be computed, and alpha shall be set equal to the last computed value of alpha. In addition, R shall be limited between KR(1) and KR(2),

where

KDR = R Divide check coefficient (n.d.),

KR(1) = Alpha pressure ratio lower limit (n.d.), and

KR(2) = Alpha pressure ratio upper limit (n.d.).

(NOTE: KR(1) is shown as KR_ADTA(1) in Table 4.39-1.)

D. Determine Alphas at Mach Boundaries – The angles of attack at the Mach boundaries are then to be determined as follows:

$$\text{ALPHA}_I = \sum_{N=1}^4 \text{KA}_{N,I} R^{N-1}, \text{ and}$$

$$\text{ALPHA}_J = \sum_{N=1}^4 \text{KA}_{N,J} R^{N-1},$$

where

I = M_INDEX,

J = M_INDEX + 1,

KA_{N,I} = Alpha/R coefficients at Mach boundary I,

KA_{N,J} = Alpha/R coefficients at Mach boundary J,

ALPHA_I = Angle of attack at Mach boundary I (deg), and

ALPHA_J = Angle of attack at Mach boundary J (deg).

Note that all angle of attack values are in degrees (not radians).

E. Determine Angle of Attack Basic – The angle of attack basic is then to be determined by linearly interpolating between the angle of attack angles at the Mach boundaries, as follows:

$$\text{ALPHA}_B = \text{ALPHA}_I + \text{M_RATIO} (\text{ALPHA}_J - \text{ALPHA}_I),$$

where

ALPHA_B = Angle of attack basic (deg).

F. Determine Delta Alpha Nose Gear – For MLY_GEAR_NOTUP = 1 (nose gear down), the delta alpha nose gear term shall be computed as follows:

$$\text{ALPHA}_\text{NG} = \sum_{N=1}^4 \text{KA}_{N,12} R^{N-1}.$$

For MLY_GEAR_NOTUP = 0, (nose gear up) ALPHA_{NG} = 0,

where

KA_{N,12} = Delta alpha nose gear/R coefficients, and

ALPHA_{NG} = Delta alpha nose gear term (deg).

G. Determine Angle of Attack – The angle of attack shall then be computed and limited between KAOA (1), and KAOA (2), as follows:

$$\text{ALPHA} = \text{ALPHA}_B + \text{ALPHA}_\text{NG},$$

where

ALPHA = Angle of attack (deg),
KAOA (1) = Alpha lower limit (deg), and
KAOA (2) = Alpha upper limit (deg).

A formulation of the AOA module is shown in Figure 5.39–2. In this formulation, the Mach range search starts using the Mach range index determined on the previous cycle. If the Mach range has changed, the next upper or lower range is tested depending on the current Mach value. This mechanization minimizes the search effort.

4.39.2.1.2 Static Source Error Correction (SSEC).

The purpose of the SSEC module is to compute corrected static pressure as a function of measured static pressure, center alpha pressure, angle of attack, Mach ratio, and a Mach range index. This module is required for the ADS, left, right, and ADTA RM air data calculations at the 1.04 Hz rate (0.5 Hz for the ADTA RM calculations).

The functions to be performed by the SSEC module are:

A. Determine Mach Range Index – A Mach range index is to be initially determined by comparing the current value of Mach to the Mach boundaries as follows:

$$\text{If } MB_SP_I \leq M \leq MB_SP_{I+1},$$

$$\text{then } M_INDEX = I,$$

where

$$I = 1, 2, 3, 4, \dots, 16, 17,$$

$$MB_SP_I = \text{Mach boundary No. } I \text{ (n.d.)},$$

$$M = \text{Current Mach No. (n.d.) from the appropriate source, and}$$

$$M_INDEX = \text{Mach range index (n.d.)}.$$

Separate Mach range indexes are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The indexes are used below.

B. Determine Mach Ratio – A Mach ratio is then to be computed based on the current Mach number and Mach boundaries as follows:

$$M_RATIO = \frac{(M - MB_SP_I)}{(MB_SP_{I+1} - MB_SP_I)},$$

where

$$M_RATIO = \text{Mach ratio (n.d.)}.$$

Separate Mach ratios are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The ratios are used below.

C. Determine the Static Pressure Coefficients at the Mach Boundaries – Based on the Mach range index from the SSEC module, this function is to determine the static pressure coefficients at the indicated Mach boundaries as follows:

$$CPS_I = \sum_{N=1}^5 KS_{N,I} ALPHA^{N-1}, \text{ and}$$

$$CPS_J = \sum_{N=1}^5 KS_{N,J} ALPHA^{N-1},$$

where

- I = M_INDEX,
- J = M_INDEX + 1,
- ALPHA = Angle of attack (deg),
- KS_{N,I} = CPS/ALPHA coefficients at Mach boundary I,
- KS_{N,J} = CPS/ALPHA coefficients at Mach boundary J,
- CPS_I = Static pressure coefficient at Mach boundary I (n.d.), and
- CPS_J = Static pressure coefficient at Mach boundary J (n.d.).

D. Determine Static Pressure Basic Coefficient – The static pressure basic coefficient at the current Mach is then to be determined by linearly interpolating between the static pressure coefficients at the Mach boundaries as follows:

$$CPS_B = CPS_I + M_RATIO(CPS_J - CPS_I)$$

where

- CPS_B = Static pressure basic coefficient (n.d.), and
- M_RATIO = Mach ratio (n.d.).

E. Determine Delta Static Pressure Nose Gear – For MLY_GEAR_NOTUP = 1 (nosegear down), the delta nose–gear static pressure term shall be computed as follows:

$$CPS_NG = \sum_{N=1}^5 KS_{N,19} ALPHA^{N-1}.$$

For MLY_GEAR_NOTUP = 0, (nose gear up) CPS_NG = 0,

where

- KS_{N,19} = Delta static pressure nose gear ALPHA coefficients, and
- CPS_NG = Delta static pressure nose–gear term (n.d.).

F. Determine Static Pressure Coefficient – The static pressure coefficient shall then be computed as follows:

$$\text{CPS} = \text{CPS}_B + \text{CPS}_{\text{NG}},$$

where

CPS = Static pressure coefficient (n.d.).

G. Determine Corrected Static Pressure – The corrected static pressure is then determined as follows:

$$\text{PSC} = \text{PS} - \text{CPS} (\text{PAC} - \text{PS}),$$

where

PS = Static pressure (in.–Hg),

PAC = Center alpha pressure (in.–Hg), and

PSC = Corrected static pressure (in.–Hg).

The ADS computed PSC shall be limited between KPSC(1) and KPSC(2),

where

KPSC(1) = Computed static pressure lower limit (in.–Hg), and

KPSC(2) = Computed static pressure upper limit (in.–Hg).

A formulation of the SSEC module is shown on Figure 5.39–3.

4.39.2.1.3 Pitot Source Error Correction (PSEC).

The purpose of the PSEC module is to compute corrected total pressure as a function of measured static pressure, center alpha pressure, angle of attack, Mach ratio, and a Mach range index. This module is required for the ADS left, right, and ADTA RM air data calculations at the 1.04 Hz rate (0.5 Hz for the ADTA RM calculations).

The functions to be performed by the PSEC module are:

A. Determine Mach Range Index – A Mach range index is to be initially determined by comparing the current value of Mach to the Mach boundaries as follows:

If $\text{MB_PT}_I \leq M \leq \text{MB_PT}_{I+1}$
then $M_INDEX = I$

where

$I = 1, 2, 3, \dots, 14,$

MB_PT_I = Mach boundary No. I (n.d.),

M = Current Mach No. (n.d.) from the appropriate source, and

M_INDEX = Mach range index (n.d.).

Separate Mach range indexes are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The indexes are used below.

B. Determine Mach Ratio – A Mach ratio is then computed based on current Mach number and the Mach boundaries as follows:

$$M_RATIO = \frac{(M - MB_PT_I)}{(MB_PT_{I+1} - MB_PT_I)},$$

where

$$M_RATIO = \text{Mach ratio (n.d.)}$$

Separate Mach ratios are to be maintained for the ADS, left, right, and ADTA RM air data calculations. The ratios are used below.

C. Determine the Total Pressure Coefficients at the Mach Boundaries – Based on the Mach range index from the PSEC module, this function is to determine the total pressure coefficient at the indicated Mach boundaries as follows:

$$CPT_I = \sum_{N=1}^5 KP_{N,I} ALPHA^{N-1}, \text{ and}$$

$$CPT_J = \sum_{N=1}^5 KP_{N,J} ALPHA^{N-1},$$

where

$$I = M_INDEX,$$

$$J = M_INDEX + 1,$$

$$KP_{N,I} = CPT/ALPHA \text{ coefficients at Mach boundary I,}$$

$$KP_{N,J} = CPT/ALPHA \text{ coefficients at Mach boundary J,}$$

$$CPT_I = \text{Total pressure coefficient at Mach boundary I (n.d.), and}$$

$$CPT_J = \text{Total pressure coefficient at Mach boundary J (n.d.)}$$

D. Determine Total Pressure Basic Coefficient – The total pressure basic coefficient at the current Mach is then to be determined by linearly interpolating between the total pressure coefficients at Mach boundaries as follows:

$$CPT_B = CPT_I + M_RATIO (CPT_J - CPT_I)$$

where

$$CPT_B = \text{Total pressure basic coefficient (n.d.), and}$$

$$M_RATIO = \text{Mach ratio (n.d.)}$$

E. Determine Delta Total Pressure Nose-gear – For MLY_GEAR_NOTUP = 1 (nose gear down), the delta total pressure nose gear term shall be computed as follows:

$$CPT_NG = \sum_{N=1}^5 KP_{N,16} ALPHA^{N-1}.$$

For MLY_GEAR_NOTUP = 0, (nose gear up) CPT_NG = 0,

where

KP_{N,16} = Delta total pressure nose-gear/ALPHA coefficients, and

CPT_NG = Delta total pressure nose-gear term (n.d.).

F. Determine Total Pressure Coefficient – The total pressure coefficient shall then be computed as follows:

$$CPT = CPT_B + CPT_NG,$$

where

CPT = Total pressure coefficient (n.d.).

G. Determine Corrected Total Pressure – The corrected total pressure shall then be determined as follows:

$$PTC = PAC - CPT (PAC - PS),$$

where

PS = Static pressure (in.-Hg),

PAC = Center alpha pressure (in.-Hg), and

PTC = Corrected total pressure (in.-Hg).

The ADS corrected total pressure shall be limited between KPTC(1) and KPTC(2),
where

KPTC(1) = Corrected total pressure lower limit (in.-Hg), and

KPTC(2) = Corrected total pressure upper limit (in.-Hg).

A formulation of the PSEC module is shown on Figure 5.39-4.

4.39.2.1.4 Mach Number (MACH).

The purpose of this subfunction shall be to calculate free stream Mach number as a function of the corrected total pressure and either limited or corrected free stream static pressure depending on whether the vehicle is in the Mach jump region or not. Mach shall not be executed until after the PSEC, SSEC, and STLIM subfunctions have been executed. Mach (V95L3029C) shall be initialized to I-load parameter M_G (V96U8446C) which has unique normal entry and RTLS values. The implicit equation for Mach is shown below. This expression is applicable for the isentropic flow of a perfect gas and is the basis on which the wind tunnel calibration data for PTC and PSC was obtained:

$$\frac{PTC}{PSC^*} = \left[1 + \frac{(\gamma - 1)}{2} M^2 \right]^{\frac{\gamma}{\gamma - 1}}$$

where

PTC = Corrected total pressure (in.-Hg),

PSC* = Corrected static pressure (in.-Hg), if not in the Mach jump region, or limited corrected static pressure (PSLIM) (in.-Hg) if in the Mach jump region, and

$\gamma = 1.4$ (exact).

The solution to the above basic equation yields the expression for Mach which shall be as follows:

$$M = \sqrt{5 \left[\left(\frac{PTC}{PSC^*} \right)^{\frac{2}{7}} - 1 \right]}$$

where

M = Free-stream Mach number (n.d.).

If the argument of the radical is negative, Mach shall be set equal to the last computed value of Mach. The computed M shall be limited between KMACH (1) and KMACH (2),

where

KMACH (1) = Mach lower limit (n.d.), and

KMACH (2) = Mach upper limit (n.d.).

A formulation of the MACH module is shown in Figure 5.39-5.

4.39.2.1.5 Pressure Altitude (PRALT).

The purpose of this subfunction shall be to calculate uncorrected pressure altitude (HPU). PRALT shall not be executed until after the SSEC subfunction has been executed. The requirements for PRALT are provided in both closed and polynomial forms.

The closed form equations for uncorrected pressure altitude (HPU) combine the perfect Gas Law with the Hydrostatic Equation. The closed form equations for the "U.S. Standard Atmosphere, 1962" are provided below.

A. For $L'm \neq 0$: (Variable Temperature Lapse Rate)

$$PSC = Pb \left[\frac{T_{M,b}}{T_{M,b} + (L'm)h} \right]^C, \text{ and}$$

B. For $L'm = 0$: (Constant Temperature Lapse Rate)

$$PSC = Pb (e^{-Kh})$$

where

- PSC = Corrected static pressure (in.-Hg),
- Pb = Pressure at base of layer (in.-Hg),
- T_{m,b} = Molecular scale temperature at base of layer (°K),
- L'm = Gradient of temperature with geopotential altitude (°K/Km),
- h = HPU – H_b, where H_b is altitude at base of layer (Km),
- C = g₀M₀/(R* L'm),
- K = g₀M₀/(R* T_{m,b}),
- g₀ = Gravity below 90 Km (9.80665 m/sec²),
- M₀ = Molecular weight (28.9644 lbm/lbm-mol), and
- R* = Universal gas constant (8.31432 joules/°K-mol).

For the "U.S. Standard Atmosphere, 1962" the following atmospheric layers and associated constants are applicable:

| <u>Atmospheric Layer</u> | <u>H_b</u> <u>(Km)</u> | <u>T_{m,b}</u> <u>(Deg K)</u> | <u>L'm</u> <u>(Deg K/Km)</u> |
|--------------------------------|-------------------------------------|--|---------------------------------|
| 0 Km ≤ H ≤ 11 Km (36,089 ft) | 0 | 288.15 | -6.5 |
| 11 Km < H ≤ 20 Km (65,617 ft) | 11 | 216.65 | 0.0 |
| 20 Km < H ≤ 32 Km (104,987 ft) | 20 | 216.65 | +1.0 |

Utilizing the above constants provides the closed form expressions for uncorrected pressure altitude. The PRALT closed form equations shall be as follows (with HPU in feet and PSC* in in.-Hg):

STS 83-0015-34
December 14, 2007

A. For $0 \text{ ft} \leq H \leq 36,089 \text{ ft}$ (that is $\text{PSC}^* \geq 6.68322 \text{ in.-Hg}$):

$$\text{HPU} = 145442.12 \left[1 - \left(\frac{\text{PSC}^*}{29.9213} \right)^{0.1902632} \right]$$

B. For $36,089 \text{ ft} < H \leq 65,617 \text{ ft}$ (that is $6.68322 \geq \text{PSC}^* > 1.616728 \text{ in.-Hg}$):

$$\text{HPU} = 20805.852 (3.6341716 - \ln \text{PSC}^*).$$

C. For $65,617 \text{ ft} < H \leq 104,987 \text{ ft}$ (that is $\text{PSC}^* \leq 1.616728 \text{ in.-Hg}$):

$$\text{HPU} = 710793.98 \left[\left(\frac{\text{PSC}^*}{1.616728} \right)^{-0.0292712} - 1 \right] + 65617,$$

where \ln = Natural logarithm to the base e

PSC^* = Corrected static pressure (PSC), if not in Mach jump, or limited corrected static pressure (PSLIM) during Mach jump.

The polynomial form of the uncorrected pressure altitude equations shall consist of three polynomials covering the range from $-1,000$ feet to $100,000$ feet. The first equation shall be a seventh-order polynomial covering the $-1,000$ to $36,830$ foot range. The second equation shall be a sixth-order polynomial covering the $36,830$ to $66,020$ -foot range. The third equation shall be a sixth-order polynomial covering the $66,020$ to $100,000$ -foot range.

The three polynomial equations shall be as follows:

A. For the altitude range of $-1,000 \leq \text{HPU} < 36,830$ feet (that is, $6.4480 \leq \text{PSC}^* < 32.00$ inches of mercury):

$$\begin{aligned} \text{HPU} = & 69828.5 - 8076.971 (\text{PSC}^*) + 670.052 (\text{PSC}^*)^2 \\ & - 42.41001 (\text{PSC}^*)^3 + 1.764952 (\text{PSC}^*)^4 \\ & - 0.04545527 (\text{PSC}^*)^5 + 0.0006550571 (\text{PSC}^*)^6 \\ & - 0.000004030813 (\text{PSC}^*)^7, \end{aligned}$$

where

PSC^* = Corrected static pressure, PSC, (in in.-Hg), if not in Mach jump, or limited corrected static pressure (PSLIM) (in.-Hg) during Mach jump region.

HPU = Uncorrected pressure altitude (feet).

B. For the altitude range of $36,830 \leq \text{HPU} < 66,020$ feet (that is, $1.5850 \leq \text{PSC}^* < 6.4480$ inches of mercury):

$$\begin{aligned} \text{HPU} = & 101805.9 - 37118.08 (\text{PSC}^*) + 13214.19 (\text{PSC}^*)^2 \\ & - 3209.696 (\text{PSC}^*)^3 + 474.4971 (\text{PSC}^*)^4 \\ & - 38.48647 (\text{PSC}^*)^5 + 1.310495 (\text{PSC}^*)^6 \end{aligned}$$

C. For the altitude range of $66,020 \leq \text{HPU} \leq 100,000$ feet (that is, $\text{PSC} \leq 1.585$ inches of mercury):

$$\begin{aligned} \text{HPU} = & 136364.1 - 180640.2 (\text{PSC}^*) + 293458.9 (\text{PSC}^*)^2 \\ & - 318475.9 (\text{PSC}^*)^3 + 207716.1 (\text{PSC}^*)^4 \\ & - 73612.32 (\text{PSC}^*)^5 + 10866.12 (\text{PSC}^*)^6 \end{aligned}$$

Note that the difference in breakpoints between the closed and polynomial equations is due to matching polynomial curves at their intersections.

Formulation of the PRALT module is shown in Figure 5.39–6.

4.39.2.1.6 Pressure Altitude Correction (PRALTC).

The purpose of this subfunction shall be to convert the keyboard–entered barometric correction to a pressure altitude correction term. This term accounts for the variations in the base level pressure at mean sea–level.

The closed and polynomial forms of the equations for the pressure altitude correction term (BARO) shall be the same as the low altitude (0 to 11 Km or –1,000 to 36,830 ft) equations used in the PRALT subfunction (see paragraph 4.39.2.1.5). However, the keyboard entered barometric correction term (VBARO) shall be used in lieu of PSC*. BARO shall be computed only if the barometric correction input has changed from the last computational cycle. BARO is used by the NSATMH subfunction to compute corrected pressure altitude.

$$\begin{aligned} \text{BARO} = & 69828.5 - 8076.971 (\text{VBARO}) + 670.052 (\text{VBARO})^2 \\ & - 42.41001 (\text{VBARO})^3 + 1.764952 (\text{VBARO})^4 \\ & - 0.04545527 (\text{VBARO})^5 + 0.0006550571 (\text{VBARO})^6 \\ & - 0.000004030813 (\text{VBARO})^7 \end{aligned}$$

where

VBARO = Keyboard entered barometric correction (in.–Hg), and
BARO = Pressure altitude correction term (ft).

The ADS computed BARO shall be limited between KBARO(1) and KBARO(2)

where

KBARO(1) = Barometric correction lower limit (ft), and
KBARO(2) = Barometric correction upper limit (ft).

A formulation of the PRALTC module is shown in Figure 5.39–7.

VBARO shall be displayed on the Horizontal Situation Spec. Function whether or not the PRALTC subfunction is executed.

4.39.2.1.7 Non-Standard Atmosphere Corrections for Temperature (NSATM).

The purpose of this subfunction shall be to compute a non-standard atmosphere correction term for improving the estimate of free-stream static air temperature. This correction term accounts for the expected variations in the temperature lapse rates of the atmospheric layers above a given landing site for the seasonal (or monthly) variations at the site. The parameters for this atmosphere correction shall be a set of constants which are mission dependent. The correction term shall be determined from sets of piece-wise continuous linear segments of the following form:

For Static Air Temperature

- A. For $ZT(1) FT \leq HPC < ZT(2) FT$
 $NSACT = TSLOPE(1) HPC + TBIAS(1);$
- B. For $ZT(2) FT \leq HPC < ZT(3) FT$
 $NSACT = TSLOPE(2) HPC + TBIAS(2);$
- C. For $ZT(3) FT \leq HPC < ZT(4) FT$
 $NSACT = TSLOPE(3) HPC + TBIAS(3);$
- D. For $ZT(4) FT \leq HPC < ZT(5) FT$
 $NSACT = TSLOPE(4) HPC + TBIAS(4);$
- E. For $ZT(5) FT \leq HPC < ZT(6) FT$
 $NSACT = TSLOPE(5) HPC + TBIAS(5);$
- F. For $ZT(6) FT \leq HPC \leq ZT(7) FT$
 $NSACT = TSLOPE(6) HPC + TBIAS(6);$

where

HPC = Corrected pressure altitude (ft),

TSLOPE(I) = Slope of static air temperature departure from the U.S. standard 1962 atmosphere in layer (I) (K/ft),

TBIAS(I) = Static air temperature bias of layer (I) at sea level (K), and

NSACT = Static air temperature departure from the U.S. standard 1962 atmosphere in layer (I) (K).

A formulation of the NSATM module is shown in Figure 5.39-8.

4.39.2.1.8 Non-Standard Atmosphere Correction For Altitude (NSATMH).

The purpose of this subfunction shall be to sum a correction term to the uncorrected pressure altitude (HPU) to generate a corrected pressure altitude (HPC). HPU is calculated in the PRALT subfunction. If HPU is above a specified altitude, the correction term NSACH (a correction term that will adjust the Standard Atmosphere 1962 to a reference atmosphere for the landing site and season) shall be computed and subtracted from HPU. If HPU is below the specified altitude, the correction term BARO (an altitude correction term computed from the actual measured pressure at the landing site) shall be subtracted from HPU. BARO is computed in the PRALTC subfunction.

This subfunction shall initially compute NSACH. This term accounts for the expected variations in the temperature lapse rates of the atmospheric layers above a given landing site for the seasonal (or monthly) variations at the site. The parameters for these atmospheres shall be a set of constants which are mission

dependent. The non-standard atmosphere correction term shall be determined from a set of piece-wise continuous linear segments of the following form:

- A. For $PALT(1) FT \leq HPU < PALT(2) FT$
 $NSACH = HSLOPE(1) HPU + HBIAS(1);$
- B. For $PALT(2) FT \leq HPU < PALT(3) FT$
 $NSACH = HSLOPE(2) HPU + HBIAS(2);$
- C. For $PALT(3) FT \leq HPU < PALT(4) FT$
 $NSACH = HSLOPE(3) HPU + HBIAS(3);$
- D. For $PALT(4) FT \leq HPU < PALT(5) FT$
 $NSACH = HSLOPE(4) HPU + HBIAS(4);$
- E. For $PALT(5) FT \leq HPU < PALT(6) FT$
 $NSACH = HSLOPE(5) HPU + HBIAS(5);$
- F. For $PALT(6) FT \leq HPU \leq PALT(7) FT$
 $NSACH = HSLOPE(6) HPU + HBIAS(6);$

where

- $PALT(I) =$ Altitude at segment breakpoint (ft),
- $HSLOPE(I) =$ Slope of altitude departure from U.S. standard 1962 atmosphere in layer (I) (n.d.),
- $HBIAS(I) =$ Altitude bias of layer (I) at sea-level (ft), and
- $NSACH =$ Altitude departure from U.S. standard 1962 atmosphere in layer (I) (ft).

(Note: $HBIAS(I)$ is shown as $HBIAS_ADTA (I)$ in Tables 4.39-1, 4.39-2, and 4.39-3.)

Corrected pressure altitude (HPC) shall then be obtained by subtracting the pressure altitude correction term (BARO) or subtracting the non-standard atmosphere correction term (NSACH) from the uncorrected pressure altitude (HPU). BARO is provided by the PRALTC subfunction and HPU by the PRALT subfunction. The ADS corrected pressure altitude shall be time tagged for use by navigation. The time tag shall reflect the time associated with the ADTA data input transaction (as defined by System Software).

- If: $HPU > KHPC(1)$
- then: $HPC = HPU - NSACH$
- else: $HPC = HPU - BARO$

where

- $HPC =$ Corrected pressure altitude (ft),
- $HPU =$ Uncorrected pressure altitude (ft),
- $BARO =$ Pressure altitude correction term (ft),
- $NSACH =$ Non-standard atmosphere correction term (ft), and
- $KHPC(1) =$ The altitude to switch from NSACH to BARO (ft).

The ADS computed HPC shall be limited between $KHPC(2)$ and $KHPC(3)$

where

KHPC(2) = Pressure altitude lower limit (ft), and

KHPC(3) = Pressure altitude upper limit (ft).

A formulation of the NSATMH module is shown in Figure 5.39–9.

4.39.2.1.9 U.S. Standard Atmosphere 1962 Model (STDATM).

The purpose of this subfunction shall be to compute free–stream static air temperature as a function of corrected pressure altitude. STDATM shall be executed before the MACH, DYPRS, EQAS, and ETRAS subfunctions are executed and after the NSATM subfunction is executed.

The equations for free–stream static air temperature, TINF, shall be:

A. For $-1000 \text{ ft} \leq \text{HPC} \leq 36089 \text{ ft}$,

$$\text{TINF} = 288.15 - 1.9811\text{E-}3 \text{ HPC} + \text{NSACT};$$

B. For $36089 \text{ ft} \leq \text{HPC} \leq 65617 \text{ ft}$,

$$\text{TINF} = 216.65 + \text{NSACT};$$

C. For $65617 \text{ ft} \leq \text{HPC} \leq 104986 \text{ ft}$,

$$\text{TINF} = 196.65 + 3.0479 \text{ E-}4 \text{ HPC} + \text{NSACT};$$

where

TINF = Estimate of free–stream static air temperature (°K),

HPC = Corrected pressure altitude

NSACT = Static air temperature departure from the U.S. Standard 1962 Atmosphere (°K).

A formulation of the STDATM module is shown in Figure 5.39–10.

4.39.2.1.10 Dynamic Pressure (DYPRS).

The purpose of this subfunction shall be to compute dynamic pressure as a function of Mach number and either limited or corrected free–stream static pressure depending on whether the vehicle is in the Mach jump region or not. DYPRS shall not be executed until after the SSEC, STLIM, and MACH subfunctions have been executed. QBAR (V95P3011C) shall be initialized to I–load parameter QBAR_G (V96U8447C) which has unique normal entry and RTLS values.

The equation for dynamic pressure, QBAR, shall be:

$$\text{QBAR} = 49.5083 (\text{PSC}^*) (\text{M}^2)$$

where

PSC* = Corrected static pressure (in.-Hg), if not in Mach jump region, or limited static pressure (PSLIM) in Mach jump region.

M = Free-stream Mach number, and

QBAR = Dynamic pressure (lb/ft²).

The ADS computed QBAR shall be limited between KQBAR(1) and KQBAR(2)

where

KQBAR(1) = Dynamic pressure lower limit (lb/ft²), and

KQBAR(2) = Dynamic pressure upper limit (lb/ft²).

A formulation of the DYPRS module is shown in Figure 5.39-11.

4.39.2.1.11 Equivalent Airspeed (EQAS).

The purpose of this subfunction shall be to compute equivalent airspeed as a function of dynamic pressure. EQAS shall not be executed until after the DYPRS subfunction has been executed.

$$EAS = 29.007567\sqrt{QBAR},$$

where

QBAR = Dynamic pressure (lb/ft²), and

EAS = Equivalent airspeed (ft/sec).

The ADS-computed EAS shall be limited between KEAS(1), and KEAS(2)

where

KEAS(1) = Equivalent airspeed lower limit (ft/sec), and

KEAS(2) = Equivalent airspeed upper limit (ft/sec).

A formulation of the EQAS module is shown in Figure 5.39-12.

4.39.2.1.12 Estimated True Airspeed (ETRAS).

The purpose of this subfunction shall be to compute an estimate of true airspeed as a function of Mach and estimated static air temperature. ETRAS shall not be executed until after the MACH and STDATM subfunctions have been executed.

The equation for estimated true airspeed shall be:

$$TAS = 65.7701(M)\sqrt{TINF},$$

where

M = Free-stream Mach number,
TINF = Estimated static air temperature (°K), and
TAS = Estimated true airspeed (ft/sec).

The computed TAS shall be limited between KVT(1) and KVT(2)

where

KVT(1) = Estimated true airspeed lower limit (ft/sec), and
KVT(2) = Estimated true airspeed upper limit (ft/sec).

A formulation of the ETRAS module is shown in Figure 5.39-13.

4.39.2.1.13 Default Air Data Parameters (DEFAD).

The purpose of this subfunction shall be to compute values for dynamic pressure (QBAR_D) and angle of attack (ALPHA_D) if the air data redundancy management principal function declares a pressure dilemma condition. These parameters are invoked in the NAV/ADS/DEFAULT Air Data Transition Function (4.39.2.2).

The equations for QBAR_D shall be:

- A. For $RELV(1) FPS \leq REL_VEL_MAG < RELV(2) FPS$
 $QBAR_D = QSLOPE(1) REL_VEL_MAG + QBIAS(1);$
- B. For $RELV(2) FPS \leq REL_VEL_MAG < RELV(3) FPS$
 $QBAR_D = QSLOPE(2) REL_VEL_MAG + QBIAS(2);$
- C. For $RELV(3) FPS \leq REL_VEL_MAG < RELV(4) FPS$
 $QBAR_D = QSLOPE(3) REL_VEL_MAG + QBIAS(3);$
- D. For $RELV(4) FPS \leq REL_VEL_MAG < RELV(5) FPS$
 $QBAR_D = QSLOPE(4) REL_VEL_MAG + QBIAS(4);$
- E. For $RELV(5) FPS \leq REL_VEL_MAG < RELV(6) FPS$
 $QBAR_D = QSLOPE(5) REL_VEL_MAG + QBIAS(5);$
- F. For $RELV(6) FPS \leq REL_VEL_MAG < RELV(7) FPS$
 $QBAR_D = QSLOPE(6) REL_VEL_MAG + QBIAS(6);$
- G. For $RELV(7) FPS \leq REL_VEL_MAG < RELV(8) FPS$
 $QBAR_D = QSLOPE(7) REL_VEL_MAG + QBIAS(7);$
- H. For $RELV(8) FPS \leq REL_VEL_MAG < RELV(9) FPS$
 $QBAR_D = QSLOPE(8) REL_VEL_MAG + QBIAS(8);$
- I. For $RELV(9) FPS \leq REL_VEL_MAG \leq RELV(10) FPS$
 $QBAR_D = QSLOPE(9) REL_VEL_MAG + QBIAS(9).$

The equations for ALPHA_D shall be:

- A. For $REL_V(1) FPS \leq REL_VEL_MAG < REL_V(11) FPS$
 $ALPHA_D = ASLOPE(1) REL_VEL_MAG + ABIAS(1);$
- B. For $REL_V(11) FPS \leq REL_VEL_MAG < REL_V(12) FPS$
 $ALPHA_D = ASLOPE(2) REL_VEL_MAG + ABIAS(2);$

where

$REL_V(I)$ = Navigation derived ground relative velocity magnitude at breakpoint(I) (ft/sec),
 $QSLOPE(I)$ = Slope of dynamic pressure versus ground relative velocity in segment(I)
(lb/ft²)/(ft/sec),
 $QBIAS(I)$ = Dynamic pressure intercept for zero ground relative velocity in segment(I) (lb/ft²),
 $ASLOPE(I)$ = Slope of angle of attack versus ground relative velocity in segment(I) (deg/fps),
 $ABIAS(I)$ = Angle of attack intercept for zero ground relative velocity in segment(I) (deg),
 REL_VEL_MAG = Navigation-derived ground relative velocity magnitude (ft/sec),
 $QBAR_D$ = Default dynamic pressure (lb/ft²),
 $ALPHA_D$ = Default angle of attack (deg).

A formulation of the DEFAD module is shown in Figure 5.39–14.

4.39.2.1.14 Static Pressure Limiter (STLIM).

The purpose of this subfunction is to limit the change in corrected static pressure during the Mach jump region. STLIM shall not be executed until after the SSEC subfunction has been executed.

INITIALIZATION:

On the first pass through the module or if a dilemma has been reset:
Set limited static pressure equal to corrected static pressure:

$$PSLIM = PSC$$

Store limited value for next comp cycle:

$$PSC(t-1) = PSLIM$$

Exit the module.

On all cycles subsequent to an initialization pass:

Compute the delta change in static pressure since last pass:

$$DELPS = PSC - PSC(t-1)$$

Limit the change as a function of corrected static pressure ($PSC(t-1)$):

$$KLIMIT = KLIMP (PSC(t-1))$$

$$DELPSL = DELPS$$

$$IF |DELPS| > KLIMIT$$

$$\text{THEN DELPSL} = \frac{\text{DELPS}}{|\text{DELPS}|} (\text{KLIMIT})$$

Define limited static pressure:

$$\text{PSLIM} = \text{PSC}(t-1) + \text{DELPSL}$$

Store limited value for next comp cycle:

$$\text{PSC}(t-1) = \text{PSLIM}$$

where

PSC = Corrected static pressure (in.-Hg)

DELPSL = Limited static pressure change (in.-Hg),

KLIMP = I-load constant used in computation of static pressure change limit,

KLIMIT = Limit on static pressure change (in.-Hg),

PSC(t-1) = Limited static pressure from previous cycle (in.-Hg),

PSLIM = Limited static pressure for current cycle (in.-Hg).

A formulation of the STLIM module is shown in Figure 5.39-18.

4.39.2.2 NAV/ADS/DEFAULT Air Data Transition.

The purpose of this function shall be to provide a transition between certain NAVDAD, ADS, and DEFAULT air data parameters. The air data parameters to be transitioned and the conditions under which the transition shall occur are specified in Figure 4.39-4, Figure 4.39-5, and Table 4.39.2-1. The transition rate for all parameters to be transitioned shall be 1.04 Hz. This function shall be executed after the ADS Air Data Calculations (4.39.2.1), the Ascent/Entry Attitude Processing principal function (4.226), the User Parameter Processor principal functions (4.23, 4.24, 4.25, and 4.20) and the NAVDAD principal function (4.122). A formulation of NAV/ADS/DEFAULT Air Data Transition is shown in Figure 5.39-1, ADS_CALC Functional Module.

Table 4.39.2-1. Output Data Set Requirements

| Data Set | Output Parameters | | | | | Output Flags | | | | OPS Use |
|----------|-------------------|-----------|-------|---------|-------------|--------------|--------|--------|--------|---------|
| | QBAR* | ALPHA | M* | EAS | TAS | PRALT | ADS_MJ | DEF_AD | ALT_DG | |
| 1 | QBAR_MJ | ALPHA_MJ | M_MJ | EAS_MJ | TAS_MJ | — | T | F | — | ↑ |
| 2 | PQBAR_MJ | PALPHA_MJ | PM_MJ | PEAS_MJ | PTAS_MJ | — | T | F | — | O |
| 3 | QBAR_A | ALPHA_A | M_A | EAS_A | TAS_A | — | F | F | — | P |
| 4 | PQBAR_A | PALPHA_A | PM_A | PEAS_A | PTAS_A | — | F | F | — | S |
| 5 | QBAR_N | ALPHA_N | M_N | EAS_N | REL_VEL_MAG | — | — | F | — | 3 |
| 6 | QBAR_D | ALPHA_D | M_N | EAS_N | REL_VEL_MAG | — | — | T | — | & |
| 7 | — | — | — | — | — | HPC | T | — | T | O |
| 8 | — | — | — | — | — | PHPC | F | — | F | P |
| 9 | — | — | — | — | — | HPC | F | — | T | S |
| 1A | QBAR_MJ | ALPHA_N | M_MJ | EAS_MJ | TAS_MJ | — | T | F | — | 6 |
| 3A | QBAR_A | ALPHA_N | M_A | EAS_A | TAS_A | — | F | F | — | ↓ |

NOTES:

(*)-(QBAR) AND (M) USE COMMON MODULES WITH STATIC PRESSURE ARGUMENT AS SHOWN BELOW:
 If MJ_STATE = 2, use PSLIM.
 If MJ_STATE = 1 or 3, use PSC.

(P) PRECEDING A VARIABLE NAME DENOTES FROZEN DATA (i.e., DO NOT UPDATE OUTPUT PARAMETER).

4.39.2.3 Left/NAV/Right Air Data Calculations.

The purpose of this function shall be to compute the following air data parameters for display on the commander's and pilot's AMI and AVVI.

- A. Angle of Attack (deg)
- B. Mach Number (n.d.)
- C. Equivalent Airspeed (knots)
- D. Corrected Pressure Altitude (ft)
- E. Pressure Altitude Rate (ft/sec)

The source of information for each of these parameters and the conditions under which they shall be switched are specified in Figure 4.39-6.

Equivalent Airspeed for the Commander's and Pilot's displays shall be switched to ground relative velocity when weight on the nose landing gear is indicated (ROLLOUT_IND = 1) and air data switch in NAV position. This is required to provide the crew with an indication of ground speed for manual braking purposes.

STS 83-0015-34
December 14, 2007

This function shall be executed after the ADTA conversion function in the ADTA RM principal function and prior to execution of the AMI and AVVI processing principal functions. In addition, the execution of this function shall occur in the computational cycle corresponding to the beginning of the AMI and AVVI processing principal function's first-order hold periods. This is required to minimize the staleness of the displayed air data parameters.

In order to generate the required parameters, this function sequentially invokes the following subfunctions:

| Subfunction | Name Description | Rate (Hz) |
|-------------|---|-----------|
| AOA | Angle of attack | 1.04 |
| SSEC | Static Source Error Correction | 1.04 |
| PSEC | Pitot Source Error Correction | 1.04 |
| NSATMH | Non-Standard Atmosphere Correction for Altitude | 1.04 |
| PRALT | Corrected Pressure Altitude | 1.04 |
| MACH | Mach Number | 1.04 |
| DYPRS | Dynamic Pressure | 1.04 |
| EQAS | Equivalent Airspeed | 1.04 |
| PARAT | Pressure Altitude Rate | 1.04 |

The requirements for the above subfunctions have been defined in paragraph 4.39.2.1. A block diagram of this function is shown in Figure 4.39-7. A formulation of this function is shown in Figure 5.39-15.

4.39.2.3.1 Pressure Altitude Rate (PARAT).

The purpose of this subfunction shall be to compute pressure altitude rate as a function of uncorrected pressure altitude changes. PARAT must not be executed until after the PRALT subfunction has been executed.

Pressure altitude rate (HDOT) shall be computed by differentiating uncorrected pressure altitude (HPU) and utilizing a cascade of two first-order lag filters. The first filter shall have a variable time constant linearly proportional to HPU. The equations for obtaining HDOT shall be as shown below:

$$HD = \left(\frac{1}{1 + (KDH1)HPU} \right) [HPU - PPHPU - (1 - (KDH1)HPU)PHD],$$

$$HDOT = KHD2 [HD + PHD + PHDOT],$$

where

HD = Altitude rate from a 1st-order lag filter with variable time constant (ft/sec),
 PHD = HD from the previous sample period (ft/sec),
 HPU = Uncorrected pressure altitude (ft),
 PPHPU = HPU (saved) that is 2 sample periods old (ft),
 HDOT = Filtered pressure altitude rate (ft/sec),
 PHDOT = HDOT from the various sample period (ft/sec), and
 KHD1, KHD2 = Constants.

This subfunction will be processed whenever the crew's ADS Source Select Switch is in the left or right position. This subfunction must be initialized to NAV altitude rate (\dot{H}_N) each time processing first begins. The initialization procedure is as follows:

$$\begin{aligned} \text{PHD} &= \dot{H}_N \text{ (ft / sec),} \\ \text{PHDOT} &= \dot{H}_N \text{ (ft / sec),} \\ \text{PHPU} &= \text{HPU} - 1 \dot{H}_N \text{ (ft),} \\ \text{PPHPU} &= \text{HPU} - 2 \dot{H}_N \text{ (ft),} \end{aligned}$$

where

PHPU = HPU from the previous sample.

A formulation of the PARAT subfunction module is shown in Figure 5.39-17.

4.39.2.4 ADTA RM Air Data Calculations.

The purpose of this function shall be to compute certain air data parameters for each ADTA output whenever either the left or right probes are deployed and the ADTA is not commfaulted. These parameters will be used by the crew to assess a pressure dilemma condition. The parameters to be executed and their execution rates shall be:

| | |
|----------------------------------|--------|
| A. Uncorrected pressure altitude | 0.5 Hz |
| B. Mach number | 0.5 Hz |
| C. Angle of attack | 0.5 Hz |

Before ADTA data can be used by this subfunction, it must be converted from counts to engineering units. Conversion is accomplished by multiplying each pressure (in counts) by the scale factor for that pressure. Repeat this for all four ADTAs. The general form of this conversion is:

$$\text{ADTA_DATA}_{I,J} = \text{ADTAM}_{I,J} \text{ADTASF}_I$$

STS 83-0015-34
December 14, 2007

where I = Each pressure
 J = Each ADTA

ADTA_DATA_{I,J} = Each pressure from each ADTA in engineering units (in.-Hg).

ADTAM_{I,J} = Each pressure from ADTA in counts (n.d).

ADTASF_I = Scale factor for pressure (I) in (in.-Hg/count).

The subfunction modules AOA (4.39.2.1.1), SSEC (4.39.2.1.2), PSEC (4.39.2.1.3), MACH (4.39.2.1.4), and PRALT (4.39.2.1.5) shall then be used to compute the parameters ALPHA_RM, M_RM, and HPU_RM for each ADTA. Corrections for the nose-gear-down conditions may be deleted from these subfunctions if software efficient. The logic requirements for execution of this function are specified in Figure-8. block diagram of the ADTA RM air data calculations is illustrated in Figure 4.39-9. A formulation of this function is shown in Figure 5.39-16.

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|--|-----------|---|------------|-------------|---------|---------------|-------|-------|
| ADS CALCULATIONS WIND TUNNEL CALIBRATIONS | | | | | | | | |
| MB_AOA(1) | V97U3722C | ANGLE OF ATTACK MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | N.D. |
| MB_AOA(2) | V97U3723C | ANGLE OF ATTACK MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | N.D. |
| MB_AOA(3) | V97U3754C | ANGLE OF ATTACK MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | N.D. |
| MB_AOA(4) | V97U3755C | ANGLE OF ATTACK MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | N.D. |
| MB_AOA(5) | V97U3756C | ANGLE OF ATTACK MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | N.D. |
| MB_AOA(6) | V97U3757C | ANGLE OF ATTACK MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | N.D. |
| MB_AOA(7) | V97U3758C | ANGLE OF ATTACK MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | N.D. |
| MB_AOA(8) | V97U3759C | ANGLE OF ATTACK MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | N.D. |
| MB_AOA(9) | V97U3760C | ANGLE OF ATTACK MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | N.D. |
| MB_AOA(10) | V97U3761C | ANGLE OF ATTACK MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | N.D. |
| MB_AOA(11) | V97U3762C | ANGLE OF ATTACK MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | N.D. |
| KA(1,1) | V97U3763C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG |
| KA(2,1) | V97U3764C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG |
| KA(3,1) | V97U3765C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG |
| KA(4,1) | V97U3766C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG |
| KA(1,2) | V97U3767C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG |
| KA(2,2) | V97U3768C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG |
| KA(3,2) | V97U3769C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG |
| KA(4,2) | V97U3770C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG |
| KA(1,3) | V97U3771C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG |
| KA(2,3) | V97U3772C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG |
| KA(3,3) | V97U3773C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG |
| KA(4,3) | V97U3774C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG |
| KA(1,4) | V97U3775C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------|-----------|--|------------|-------------|---------|---------------|-------|-------|
| KA(2,4) | V97U3776C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG |
| KA(3,4) | V97U3777C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG |
| KA(4,4) | V97U3778C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG |
| KA(1,5) | V97U3779C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG |
| KA(2,5) | V97U3780C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG |
| KA(3,5) | V97U3781C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG |
| KA(4,5) | V97U3782C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG |
| KA(1,6) | V97U3783C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG |
| KA(2,6) | V97U3784C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG |
| KA(3,6) | V97U3785C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG |
| KA(4,6) | V97U3786C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG |
| KA(1,7) | V97U3787C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG |
| KA(2,7) | V97U3788C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG |
| KA(3,7) | V97U3789C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG |
| KA(4,7) | V97U3790C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG |
| KA(1,8) | V97U3791C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG |
| KA(2,8) | V97U3792C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG |
| KA(3,8) | V97U3793C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG |
| KA(4,8) | V97U3794C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG |
| KA(1,9) | V97U3795C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG |
| KA(2,9) | V97U3796C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG |
| KA(3,9) | V97U3797C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG |
| KA(4,9) | V97U3798C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG |
| KA(1,10) | V97U3799C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG |
| KA(2,10) | V97U3800C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG |
| KA(3,10) | V97U3801C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------|-----------|---|------------|-------------|---------|---------------|-------|-------|
| KA(4,10) | V97U3802C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG |
| KA(1,11) | V97U3803C | ALPHA/R COEFFICIENT 1-MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG |
| KA(2,11) | V97U3804C | ALPHA/R COEFFICIENT 2-MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG |
| KA(3,11) | V97U3805C | ALPHA/R COEFFICIENT 3-MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG |
| KA(4,11) | V97U3806C | ALPHA/R COEFFICIENT 4-MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG |
| KA(1,12) | V97U3807C | ALPHA/R COEFFICIENT 1-NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG |
| KA(2,12) | V97U3808C | ALPHA/R COEFFICIENT 2-NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG |
| KA(3,12) | V97U3809C | ALPHA/R COEFFICIENT 3-NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG |
| KA(4,12) | V97U3810C | ALPHA/R COEFFICIENT 4-NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG |
| MB_SP(1) | V97U3726C | STATIC PRESSURE MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | N.D. |
| MB_SP(2) | V97U3727C | STATIC PRESSURE MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | N.D. |
| MB_SP(3) | V97U3728C | STATIC PRESSURE MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | N.D. |
| MB_SP(4) | V97U3729C | STATIC PRESSURE MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | N.D. |
| MB_SP(5) | V97U3730C | STATIC PRESSURE MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | N.D. |
| MB_SP(6) | V97U3731C | STATIC PRESSURE MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | N.D. |
| MB_SP(7) | V97U3732C | STATIC PRESSURE MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | N.D. |
| MB_SP(8) | V97U3733C | STATIC PRESSURE MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | N.D. |
| MB_SP(9) | V97U3734C | STATIC PRESSURE MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | N.D. |
| MB_SP(10) | V97U3735C | STATIC PRESSURE MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | N.D. |
| MB_SP(11) | V97U3736C | STATIC PRESSURE MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | N.D. |
| MB_SP(12) | V97U3811C | STATIC PRESSURE MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | N.D. |
| MB_SP(13) | V97U3812C | STATIC PRESSURE MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | N.D. |
| MB_SP(14) | V97U3813C | STATIC PRESSURE MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | N.D. |
| MB_SP(15) | V97U3814C | STATIC PRESSURE MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | N.D. |
| MB_SP(16) | V97U3815C | STATIC PRESSURE MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | N.D. |
| MB_SP(17) | V97U3816C | STATIC PRESSURE MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | N.D. |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------|-----------|--|------------|-------------|---------|---------------|-------|---------|
| MB_SP(18) | V97U3817C | STATIC PRESSURE MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | N.D. |
| KS(1,1) | V97U3818C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | N.D. |
| KS(2,1) | V97U3819C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,1) | V97U3820C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,1) | V97U3821C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,1) | V97U3822C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,2) | V97U3823C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | N.D. |
| KS(2,2) | V97U3824C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,2) | V97U3825C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,2) | V97U3826C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,2) | V97U3827C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,3) | V97U3828C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | N.D. |
| KS(2,3) | V97U3829C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,3) | V97U3830C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,3) | V97U3831C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,3) | V97U3832C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,4) | V97U3833C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | N.D. |
| KS(2,4) | V97U3834C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,4) | V97U3835C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,4) | V97U3836C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,4) | V97U3837C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,5) | V97U3838C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | N.D. |
| KS(2,5) | V97U3839C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,5) | V97U3840C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,5) | V97U3841C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,5) | V97U3842C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG**_4 |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------|-----------|---|------------|-------------|---------|---------------|-------|---------|
| KS(1,6) | V97U3843C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | N.D. |
| KS(2,6) | V97U3844C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,6) | V97U3845C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,6) | V97U3846C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,6) | V97U3847C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,7) | V97U3848C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | N.D. |
| KS(2,7) | V97U3849C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,7) | V97U3850C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,7) | V97U3851C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,7) | V97U3852C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,8) | V97U3853C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | N.D. |
| KS(2,8) | V97U3854C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,8) | V97U3855C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,8) | V97U3856C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,8) | V97U3857C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,9) | V97U3858C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | N.D. |
| KS(2,9) | V97U3859C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,9) | V97U3860C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,9) | V97U3861C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,9) | V97U3862C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,10) | V97U3863C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | N.D. |
| KS(2,10) | V97U3864C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,10) | V97U3865C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,10) | V97U3866C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,10) | V97U3867C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,11) | V97U3868C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | N.D. |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------|-----------|---|------------|-------------|---------|---------------|-------|---------|
| KS(2,11) | V97U3869C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,11) | V97U3870C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,11) | V97U3871C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,11) | V97U3872C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,12) | V97U3873C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | N.D. |
| KS(2,12) | V97U3874C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,12) | V97U3875C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,12) | V97U3876C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,12) | V97U3877C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,13) | V97U3878C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | N.D. |
| KS(2,13) | V97U3879C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,13) | V97U3880C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,13) | V97U3881C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,13) | V97U3882C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,14) | V97U3883C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | N.D. |
| KS(2,14) | V97U3884C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,14) | V97U3885C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,14) | V97U3886C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,14) | V97U3887C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,15) | V97U3888C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | N.D. |
| KS(2,15) | V97U3889C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,15) | V97U3890C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,15) | V97U3891C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,15) | V97U3892C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,16) | V97U3893C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | N.D. |
| KS(2,16) | V97U3894C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | DEG**_1 |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------|-----------|--|------------|-------------|---------|---------------|-------|---------|
| KS(3,16) | V97U3895C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,16) | V97U3896C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,16) | V97U3897C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 16 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,17) | V97U3898C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | N.D. |
| KS(2,17) | V97U3899C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,17) | V97U3300C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,17) | V97U3301C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,17) | V97U3302C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 17 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,18) | V97U3303C | CPS/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | N.D. |
| KS(2,18) | V97U3304C | CPS/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | DEG**_1 |
| KS(3,18) | V97U3305C | CPS/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | DEG**_2 |
| KS(4,18) | V97U3306C | CPS/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | DEG**_3 |
| KS(5,18) | V97U3307C | CPS/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 18 | D | FLOAT PT | | | | DEG**_4 |
| KS(1,19) | V97U3308C | CPS/ALPHA COEFFICIENT1 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | N.D. |
| KS(2,19) | V97U3309C | CPS/ALPHA COEFFICIENT2 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_1 |
| KS(3,19) | V97U3310C | CPS/ALPHA COEFFICIENT3 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_2 |
| KS(4,19) | V97U3311C | CPS/ALPHA COEFFICIENT4 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_3 |
| KS(5,19) | V97U3312C | CPS/ALPHA COEFFICIENT5 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_4 |
| MB_PT(1) | V97U3724C | TOTAL PRESSURE MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | N.D. |
| MB_PT(2) | V97U3725C | TOTAL PRESSURE MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | N.D. |
| MB_PT(3) | V97U3313C | TOTAL PRESSURE MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | N.D. |
| MB_PT(4) | V97U3314C | TOTAL PRESSURE MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | N.D. |
| MB_PT(5) | V97U3315C | TOTAL PRESSURE MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | N.D. |
| MB_PT(6) | V97U3316C | TOTAL PRESSURE MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | N.D. |
| MB_PT(7) | V97U3317C | TOTAL PRESSURE MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | N.D. |
| MB_PT(8) | V97U3318C | TOTAL PRESSURE MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | N.D. |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------|-----------|--|------------|-------------|---------|---------------|-------|---------|
| MB_PT(9) | V97U3319C | TOTAL PRESSURE MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | N.D. |
| MB_PT(10) | V97U3320C | TOTAL PRESSURE MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | N.D. |
| MB_PT(11) | V97U3321C | TOTAL PRESSURE MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | N.D. |
| MB_PT(12) | V97U3322C | TOTAL PRESSURE MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | N.D. |
| MB_PT(13) | V97U3323C | TOTAL PRESSURE MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | N.D. |
| MB_PT(14) | V97U3324C | TOTAL PRESSURE MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | N.D. |
| MB_PT(15) | V97U3325C | TOTAL PRESSURE MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | N.D. |
| KP(1,1) | V97U3326C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | N.D. |
| KP(2,1) | V97U3327C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,1) | V97U3328C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,1) | V97U3329C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,1) | V97U3330C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 1 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,2) | V97U3331C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | N.D. |
| KP(2,2) | V97U3332C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,2) | V97U3333C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,2) | V97U3334C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 2 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,2) | V97U3335C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,3) | V97U3336C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | N.D. |
| KP(2,3) | V97U3337C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,3) | V97U3338C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,30) | V97U3339C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,3) | V97U3340C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 3 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,4) | V97U3341C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | N.D. |
| KP(2,4) | V97U3342C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,4) | V97U3343C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,4) | V97U3344C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG**_3 |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|---------|-----------|--|------------|-------------|---------|---------------|-------|----------|
| KP(5,4) | V97U3345C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 4 | D | FLOAT PT | | | | DEG** -4 |
| KP(1,5) | V97U3346C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | N.D. |
| KP(2,5) | V97U3347C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG** -1 |
| KP(3,5) | V97U3348C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG** -2 |
| KP(4,5) | V97U3349C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG** -3 |
| KP(5,5) | V97U3350C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 5 | D | FLOAT PT | | | | DEG** -5 |
| KP(1,6) | V97U3351C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | N.D. |
| KP(2,6) | V97U3352C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG** -1 |
| KP(3,6) | V97U3353C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG** -2 |
| KP(4,6) | V97U3354C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG** -3 |
| KP(5,6) | V97V3355C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 6 | D | FLOAT PT | | | | DEG** -4 |
| KP(1,7) | V97U3356C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | N.D. |
| KP(2,7) | V97U3357C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG** -1 |
| KP(3,7) | V97U3358C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG** -2 |
| KP(4,7) | V97U3359C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG** -3 |
| KP(5,7) | V97U3360C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 7 | D | FLOAT PT | | | | DEG** -4 |
| KP(1,8) | V97U3361C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | N.D. |
| KP(2,8) | V97U3362C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG** -1 |
| KP(3,8) | V97U3363C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG** -2 |
| KP(4,8) | V97U3364C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG** -3 |
| KP(5,8) | V97U3365C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 8 | D | FLOAT PT | | | | DEG** -4 |
| KP(1,9) | V97U3366C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | N.D. |
| KP(2,9) | V97U3367C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG** -1 |
| KP(3,9) | V97U3368C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG** -2 |
| KP(4,9) | V97U3369C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG** -3 |
| KP(5,9) | V97U3370C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 9 | D | FLOAT PT | | | | DEG** -4 |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------|-----------|---|------------|-------------|---------|---------------|-------|---------|
| KP(1,10) | V97U3371C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | N.D. |
| KP(2,10) | V97U3372C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,10) | V97U3373C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,10) | V97U3374C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,10) | V97U3375C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 10 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,11) | V97U3376C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | N.D. |
| KP(2,11) | V97U3377C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,11) | V97U3378C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,11) | V97U3379C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,11) | V97U3380C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 11 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,12) | V97U3381C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | N.D. |
| KP(2,12) | V97U3382C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,12) | V97U3383C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,12) | V97U3384C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,12) | V97U3385C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 12 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,13) | V97U3386C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | N.D. |
| KP(2,13) | V97U3387C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,13) | V97U3388C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,13) | V97U3389C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,13) | V97U3390C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 13 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,14) | V97U3391C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | N.D. |
| KP(2,14) | V97U3392C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,14) | V97U3393C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,14) | V97U3394C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,14) | V97U3395C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 14 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,15) | V97U3396C | CPT/ALPHA COEFFICIENT1 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | N.D. |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------|-----------|--|------------|-------------|----------|---------------|-------|----------|
| KP(2,15) | V97U3397C | CPT/ALPHA COEFFICIENT2 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_1 |
| KP(3,15) | V97U3398C | CPT/ALPHA COEFFICIENT3 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_2 |
| KP(4,15) | V97U3399C | CPT/ALPHA COEFFICIENT4 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_3 |
| KP(5,15) | V98U9432C | CPT/ALPHA COEFFICIENT5 MACH BOUNDARY NO. 15 | D | FLOAT PT | | | | DEG**_4 |
| KP(1,16) | V98U9433C | CPT/ALPHA COEFFICIENT1 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | N.D. |
| KP(2,16) | V98U9434C | CPT/ALPHA COEFFICIENT2 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_1 |
| KP(3,16) | V98U7924C | CPT/ALPHA COEFFICIENT3 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_2 |
| KP(4,16) | V98U9436C | CPT/ALPHA COEFFICIENT4 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_3 |
| KP(5,16) | V98U9437C | CPT/ALPHA COEFFICIENT5 NOSE GEAR DOWN EFFECT | D | FLOAT PT | | | | DEG**_4 |
| CONSTANTS | | | | | | | | |
| V_FREEZE | V98U9439C | ALPHA SW THRESHOLD VELOCITY | D | FLOAT PT | | | | FT/SEC |
| V_NAV/DEF | V98U9438C | NAVDAD/DEFAULT SWITCH VELOCITY | D | FLOAT PT | | | | FT/SEC |
| V_ADS | V98U9440C | AIR DATA ENABLE VELOCITY | D | FLOAT PT | | | | FT/SEC |
| KLIMP | V96U9382C | STATIC PRESSURE LIMITER GAIN | D | FLOAT PT | 03 01 | | | |
| TSLOPE(1) | V98U9460C | STATIC AIR TEMPERATURE GRADIENT(1) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TSLOPE(2) | V98U9461C | STATIC AIR TEMPERATURE GRADIENT(2) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TSLOPE(3) | V98U9462C | STATIC AIR TEMPERATURE GRADIENT(3) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TSLOPE(4) | V98U9463C | STATIC AIR TEMPERATURE GRADIENT(4) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TSLOPE(5) | V98U9464C | STATIC AIR TEMPERATURE GRADIENT(5) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TSLOPE(6) | V98U9465C | STATIC AIR TEMPERATURE GRADIENT(6) | M | FLOAT PT | 03 01 | | | DEG K/FT |
| TBIAS(1) | V98U9466C | STATIC AIR TEMPERATURE BIAS(1) | M | FLOAT PT | 03 01 | | | DEG K |
| TBIAS(2) | V98U9467C | STATIC AIR TEMPERATURE BIAS(2) | M | FLOAT PT | 03 01 | | | DEG K |
| TBIAS(3) | V98U9468C | STATIC AIR TEMPERATURE BIAS(3) | M | FLOAT PT | 03 01 | | | DEG K |
| TBIAS(4) | V98U9469C | STATIC AIR TEMPERATURE BIAS(4) | M | FLOAT PT | 03 01 | | | DEG K |
| TBIAS(5) | V98U9470C | STATIC AIR TEMPERATURE BIAS(5) | M | FLOAT PT | 03 01 | | | DEG K |
| TBIAS(6) | V98U9471C | STATIC AIR TEMPERATURE BIAS(6) | M | FLOAT PT | 03 01 | | | DEG K |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|---------------|-----------|----------------------------------|------------|-------------|----------|---------------|-------|-------|
| ZT(1) | V98U9472C | STATIC TEMPERATURE BREAKPOINT(1) | M | FLOAT PT | 03 01 | | | FT |
| ZT(2) | V98U9473C | STATIC TEMPERATURE BREAKPOINT(2) | M | FLOAT PT | 03 01 | | | FT |
| ZT(3) | V98U9474C | STATIC TEMPERATURE BREAKPOINT(3) | M | FLOAT PT | 03 01 | | | FT |
| ZT(4) | V98U9475C | STATIC TEMPERATURE BREAKPOINT(4) | M | FLOAT PT | 03 01 | | | FT |
| ZT(5) | V98U9476C | STATIC TEMPERATURE BREAKPOINT(5) | M | FLOAT PT | 03 01 | | | FT |
| ZT(6) | V98U9477C | STATIC TEMPERATURE BREAKPOINT(6) | M | FLOAT PT | 03 01 | | | FT |
| ZT(7) | V98U9478C | STATIC TEMPERATURE BREAKPOINT(7) | M | FLOAT PT | 03 01 | | | FT |
| HSLOPE(1) | V98U9479C | ALTITUDE DEPARTURE GRADIENT(1) | M | FLOAT PT | 03 01 | | | N.D. |
| HSLOPE(2) | V98U9480C | ALTITUDE DEPARTURE GRADIENT(2) | M | FLOAT PT | 03 01 | | | N.D. |
| HSLOPE(3) | V98U9481C | ALTITUDE DEPARTURE GRADIENT(3) | M | FLOAT PT | 03 01 | | | N.D. |
| HSLOPE(4) | V98U9482C | ALTITUDE DEPARTURE GRADIENT(5) | M | FLOAT PT | 03 01 | | | N.D. |
| HSLOPE(5) | V98U9483C | ALTITUDE DEPARTURE GRADIENT(5) | M | FLOAT PT | 03 01 | | | N.D. |
| HSLOPE(6) | V98U9484C | ALTITUDE DEPARTURE GRADIENT(6) | M | FLOAT PT | 03 01 | | | N.D. |
| HBIAS_ADTA(1) | V98U9485C | ALTITUDE DEPARTURE BIAS(1) | M | FLOAT PT | 03 01 | | | FT |
| HBIAS_ADTA(2) | V98U9486C | ALTITUDE DEPARTURE BIAS(2) | M | FLOAT PT | 03 01 | | | FT |
| HBIAS_ADTA(3) | V98U9487C | ALTITUDE DEPARTURE BIAS(3) | M | FLOAT PT | 03 01 | | | FT |
| HBIAS_ADTA(4) | V98U9488C | ALTITUDE DEPARTURE BIAS(4) | M | FLOAT PT | 03 01 | | | FT |
| HBIAS_ADTA(5) | V98U9489C | ALTITUDE DEPARTURE BIAS(5) | M | FLOAT PT | 03 01 | | | FT |
| HBIAS_ADTA(6) | V98U9490C | ALTITUDE DEPARTURE BIAS(6) | M | FLOAT PT | 03 01 | | | FT |
| PALT(1) | V98U9491C | ALTITUDE DEPARTURE BREAKPOINT(1) | M | FLOAT PT | 03 01 | | | FT |
| PALT(2) | V98U9492C | ALTITUDE DEPARTURE BREAKPOINT(2) | M | FLOAT PT | 03 01 | | | FT |
| PALT(3) | V98U9493C | ALTITUDE DEPARTURE BREAKPOINT(3) | M | FLOAT PT | 03 01 | | | FT |
| PALT(4) | V98U9494C | ALTITUDE DEPARTURE BREAKPOINT(4) | M | FLOAT PT | 03 01 | | | FT |
| PALT(5) | V98U9495C | ALTITUDE DEPARTURE BREAKPOINT(5) | M | FLOAT PT | 03 01 | | | FT |
| PALT(6) | V98U9496C | ALTITUDE DEPARTURE BREAKPOINT(6) | M | FLOAT PT | 03 01 | | | FT |
| PALT(7) | V98U9497C | ALTITUDE DEPARTURE BREAKPOINT(7) | M | FLOAT PT | 03 01 | | | FT |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------|-----------|--|------------|-------------|---------|---------------|-------|-----------|
| QSLOPE(1) | V98U9498C | DEFAULT QBAR GRADIENT(1) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(2) | V98U9499C | DEFAULT QBAR GRADIENT(2) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(3) | V98U9500C | DEFAULT QBAR GRADIENT(3) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(4) | V98U9501C | DEFAULT QBAR GRADIENT(4) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(5) | V98U9502C | DEFAULT QBAR GRADIENT(5) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(6) | V98U9503C | DEFAULT QBAR GRADIENT(6) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(7) | V98U9504C | DEFAULT QBAR GRADIENT(7) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(8) | V98U9505C | DEFAULT QBAR GRADIENT(8) | M | FLOAT PT | | | | PSF/FPS |
| QSLOPE(9) | V98U9506C | DEFAULT QBAR GRADIENT(9) | M | FLOAT PT | | | | PSF/FPS |
| QBIAS(1) | V98U9507C | DEFAULT QBAR BIAS(1) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(2) | V98U9508C | DEFAULT QBAR BIAS(2) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(3) | V98U9509C | DEFAULT QBAR BIAS(3) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(4) | V98U9510C | DEFAULT QBAR BIAS(4) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(5) | V98U9511C | DEFAULT QBAR BIAS(5) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(6) | V98U9512C | DEFAULT QBAR BIAS(6) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(7) | V98U9513C | DEFAULT QBAR BIAS(7) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(8) | V98U9514C | DEFAULT QBAR BIAS(8) | M | FLOAT PT | | | | LB/SQ FT |
| QBIAS(9) | V98U9515C | DEFAULT QBAR BIAS(9) | M | FLOAT PT | | | | LB/SQ FT |
| RELV(1) | V98U9516C | GROUND RELATIVE VEL. BREAKPOINT(1) | M | FLOAT PT | | | | FT/SEC |
| RELV(2) | V98U9517C | GROUND RELATIVE VEL. BREAKPOINT(2) | M | FLOAT PT | | | | FT/SEC |
| RELV(3) | V98U9518C | GROUND RELATIVE VEL. BREAKPOINT(3) | M | FLOAT PT | | | | FT/SEC |
| RELV(4) | V98U9519C | GROUND RELATIVE VEL. BREAKPOINT(4) | M | FLOAT PT | | | | FT/SEC |
| RELV(5) | V98U9520C | GROUND RELATIVE VEL. BREAKPOINT(5) | M | FLOAT PT | | | | FT/SEC |
| RELV(6) | V98U9521C | GROUND RELATIVE VEL. BREAKPOINT(6) | M | FLOAT PT | | | | FT/SEC |
| RELV(7) | V98U9522C | GROUND RELATIVE VEL. BREAKPOINT(7) | M | FLOAT PT | | | | FT/SEC |
| RELV(8) | V98U9523C | GROUND RELATIVE VEL. BREAKPOINT(8) | M | FLOAT PT | | | | FT/SEC |
| RELV(9) | V98U9524C | GROUND RELATIVE VEL. BREAKPOINT(9) | M | FLOAT PT | | | | FT/SEC |
| RELV(10) | V98U9525C | GROUND RELATIVE VEL. BREAKPOINT(10) | M | FLOAT PT | | | | FT/SEC |
| RELV(11) | V98U9526C | GROUND RELATIVE VEL. BREAKPOINT(11) | M | FLOAT PT | | | | FPS |
| RELV(12) | V98U9527C | GROUND RELATIVE VEL. BREAKPOINT(12) | M | FLOAT PT | | | | FPS |
| ASLOPE(1) | V98U9528C | DEFAULT ALPHA GRADIENT(1) | M | FLOAT PT | | | | DEG/FPS |
| ASLOPE(2) | V98U9529C | DEFAULT ALPHA GRADIENT(2) | M | FLOAT PT | | | | DEG/FPS |
| ABIAS(1) | V98U9530C | DEFAULT ALPHA BIAS(1) | M | FLOAT PT | | | | DEG |
| ABIAS(2) | V98U9531C | DEFAULT ALPHA BIAS(2) | M | FLOAT PT | | | | DEG |
| ADTASF(1) | | STATIC PRESSURE SCALE FACTOR (PS) | R | FLOAT PT | | 1.0987E-3 | | IN-HG/COU |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|----------------|-----------|--|------------|-------------|---------|---------------|-------|-----------|
| ADTASF(3) | | CENTER ALPHA PRESSURE SCALE FACTOR (PAC) | R | FLOAT PT | | 1.5870E-3 | | IN-HG/COU |
| ADTASF(5) | | UPPER ALPHA PRESSURE SCALE FACTOR (PAU) | R | FLOAT PT | | 1.5870E-3 | | IN-HG/COU |
| ADTASF(6) | | LOWER ALPHA PRESSURE SCALE FACTOR (PAL) | R | FLOAT PT | | 1.5870E-3 | | IN-HG/COU |
| KHD1 | V97U3512C | HDOT FILTER CONSTANT(1) | K | FLOAT PT | | +4.0000E-5 | | FT/SEC |
| KHD2 | V98U9537C | HDOT FILTER CONSTANT(2) | K | FLOAT PT | | +3.3330E-1 | | N.D. |
| INITIALIZATION | | | | | | | | |
| M | V95L3029C | GN&C MACH NUMBER | K | FLOAT PT | | 25.0 | | N.D. |
| M_G | V96U8446C | GN&C MACH NUMBER FOR GRTLS | M | FLOAT PT | | | | N.D. |
| QBAR_G | V96U8447C | GN&C DYNAMIC PRESSURE FOR GRTLS | M | FLOAT PT | | | | LB/SQ FT |
| ALPHA | V95H3021C | GN&C ANGLE OF ATTACK | | FLOAT PT | | 12.0 | | DEG |
| QBAR | V95P3011C | GN&C DYNAMIC PRESSURE | | FLOAT PT | | | | LB/SQ FT |
| EAS | V95L3145C | GN&C EQUIVALENT AIRSPEED | | FLOAT PT | | 430.0 | | FT/SEC |
| TAS | V95L3015C | GN&C TRUE AIRSPEED | | FLOAT PT | | 2800.0 | | FT/SEC |
| HPC | V95H3001C | ADS CORRECTED PRESSURE ALTITUDE | | FLOAT PT | | 90000.0 | | FT |
| NSACH | | NON-STANDARD ALTITUDE CORRECTION TERM | | FLOAT PT | | 0.0 | | FT |
| VBARO | | BAROSET CORRECTION | | FLOAT PT | | 29.92 | | IN-HG |
| LIMITS | | | | | | | | |
| KDR_ADTA | V98U9532C | ALPHA RATIO DIVIDE CK. | K | FLOAT PT | | +2.0E-3 | | N.D. |
| KR_ADTA(1) | V98U9533C | RATIO LOWER LIMIT | K | FLOAT PT | | -2.25 | | N.D. |
| KR_ADTA(2) | V98U9534C | RATIO UPPER LIMIT | K | FLOAT PT | | +1.75 | | N.D. |
| KAOA(1) | V98U9535C | ALPHA LOWER LIMIT | K | FLOAT PT | | -4.0 | | DEG |
| KAOA(2) | V98U9536C | ALPHA UPPER LIMIT | D | FLOAT PT | | | | DEG |
| KMACH(1) | V97U3526C | MACH LOWER LIMIT | K | FLOAT PT | | +1.0E-1 | | N.D. |
| KMACH(2) | V97U3527C | MACH UPPER LIMIT | D | FLOAT PT | | | | N.D. |
| KPSC(1) | V98U9538C | CORRECTED STATIC PRESSURE LOWER LIMIT | D | FLOAT PT | | | | IN-HG |
| KPSC(2) | V98U9539C | CORRECTED STATIC PRESSURE UPPER LIMIT | K | FLOAT PT | | +3.6E+1 | | IN-HG |
| KPTC(1) | V98U9540C | CORRECTED TOTAL PRESSURE LOWER LIMIT | D | FLOAT PT | | | | IN-HG |
| KPTC(2) | V98U9541C | CORRECTED TOTAL PRESSURE UPPER LIMIT | K | FLOAT PT | | +5.2E+1 | | IN-HG |
| KHPC(1) | V98U9542C | BARO/NON STD ATMOS SWITCH POINT | D | FLOAT PT | | | | FT |
| KHPC(2) | V98U9543C | PRESSURE ALTITUDE LOWER LIMIT | K | FLOAT PT | | 0.0 | | FT |
| KHPC(3) | V98U9544C | PRESSURE ALTITUDE UPPER LIMIT | D | FLOAT PT | | | | FT |
| KBARO(1) | V98U9545C | PRESSURE ALTITUDE CORRECTION LOWER LIMIT | K | FLOAT PT | | -1.0E+3 | | FT |

Table 4.39-1. ADTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Mem Con | Nominal Value | Range | Units |
|-----------------------|-----------|--|------------|-------------|---------|---------------|-------|----------|
| KBARO(2) | V98U9546C | PRESSURE ALTITUDE CORRECTION UPPER LIMIT | K | FLOAT PT | | +8.0E+3 | | FT |
| KQBAR(1) | V97U3587C | DYNAMIC PRESSURE LOWER LIMIT | K | FLOAT PT | | +1.48E+1 | | LB/SQ FT |
| KQBAR(2) | V97U3588C | DYNAMIC PRESSURE UPPER LIMIT | K | FLOAT PT | | +3.75E+2 | | LB/SQ FT |
| KEAS(1) | V98U9549C | EQUIVALENT AIRSPEED LOWER LIMIT | K | FLOAT PT | | +1.12E+2 | | FT/SEC |
| KEAS(2) | V98U9550C | EQUIVALENT AIRSPEED UPPER LIMIT | K | FLOAT PT | | +5.62E+2 | | FT/SEC |
| KVT(1) | V97U3718C | TRUE AIRSPEED LOWER LIMIT | K | FLOAT PT | | +1.12E+2 | | FT/SEC |
| KVT(2) | V97U3719C | TRUE AIRSPEED UPPER LIMIT | D | FLOAT PT | | | | FT/SEC |
| MJ(1) | V98U9551C | MACH JUMP LOWER LIMIT | D | FLOAT PT | | | | N.D. |
| MJ(2) | V98U9552C | MACH JUMP UPPER LIMIT | D | FLOAT PT | | | | N.D. |
| FLAGS | | | | | | | | |
| ALT_DG | V95X3110X | PRESS ALT. DATA GOOD | | DISCRETE | | F | | |
| DEF_AD | V95X3039X | DEFAULT AIR DATA FLAG | | DISCRETE | | F | | |
| AUTO_LATCH | | AUTO TRANSITION LATCH | | DISCRETE | | F | | |
| L/R CALCULATION FLAGS | | | | | | | | |
| ADPVALIDC | V95X3115X | CMDR LEFT AIR DATA VALID | | DISCRETE | | F | | |
| ADPVALIDP | V95X3117X | PILOT RIGHT AIR DATA VALID | | DISCRETE | | F | | |
| LADIC | | CMDR LEFT AIR DATA INITIALIZE | | DISCRETE | | T | | |
| LADIP | | PILOT LEFT AIR DATA INITIALIZE | | DISCRETE | | T | | |
| RADIC | | CMDR RIGHT AIR DATA INITIALIZE | | DISCRETE | | T | | |
| RADIP | | PILOT RIGHT AIR DATA INITIALIZE | | DISCRETE | | T | | |
| ADTA RM CALCULATIONS | | | | | | | | |
| RMMI | | RM MACH INITIALIZE | | DISCRETE | | F | | |
| M_RM(1) | V95L3180C | ADTA 1 MACH INDICATION | | FLOAT PT | | 0.0 | | N.D. |
| M_RM(2) | V95L3181C | ADTA 2 MACH INDICATION | | FLOAT PT | | 0.0 | | N.D. |
| M_RM(3) | V95L3182C | ADTA 3 MACH INDICATION | | FLOAT PT | | 0.0 | | N.D. |
| M_RM(4) | V95L3183C | ADTA 4 MACH INDICATION | | FLOAT PT | | 0.0 | | N.D. |
| ALPHA_RM(1) | V95H3186C | ADTA 1 ALPHA INDICATION | | FLOAT PT | | 0.0 | | DEG |
| ALPHA_RM(2) | V95H3187C | ADTA 2 ALPHA INDICATION | | FLOAT PT | | 0.0 | | DEG |
| ALPHA_RM(3) | V95H3188C | ADTA 3 ALPHA INDICATION | | FLOAT PT | | 0.0 | | DEG |
| ALPHA_RM(4) | V95H3189C | ADTA 4 ALPHA INDICATION | | FLOAT PT | | 0.0 | | DEG |
| HPU_RM(1) | V95H3193C | ADTA 1 ALT INDICATION | | FLOAT PT | | 0.0 | | FT |
| HPU_RM(2) | V95H3194C | ADTA 2 ALT INDICATION | | FLOAT PT | | 0.0 | | FT |
| HPU_RM(3) | V95H3195C | ADTA 3 ALT INDICATION | | FLOAT PT | | 0.0 | | FT |
| HPU_RM(4) | V95H3196C | ADTA 4 ALT INDICATION | | FLOAT PT | | 0.0 | | FT |

NOTE: IF MEMORY CONFIGURATION COLUMN IS BLANK, NOMINAL VALUE AS SHOWN APPLIES TO ALL APPLICABLE MEMORY CONFIGURATON

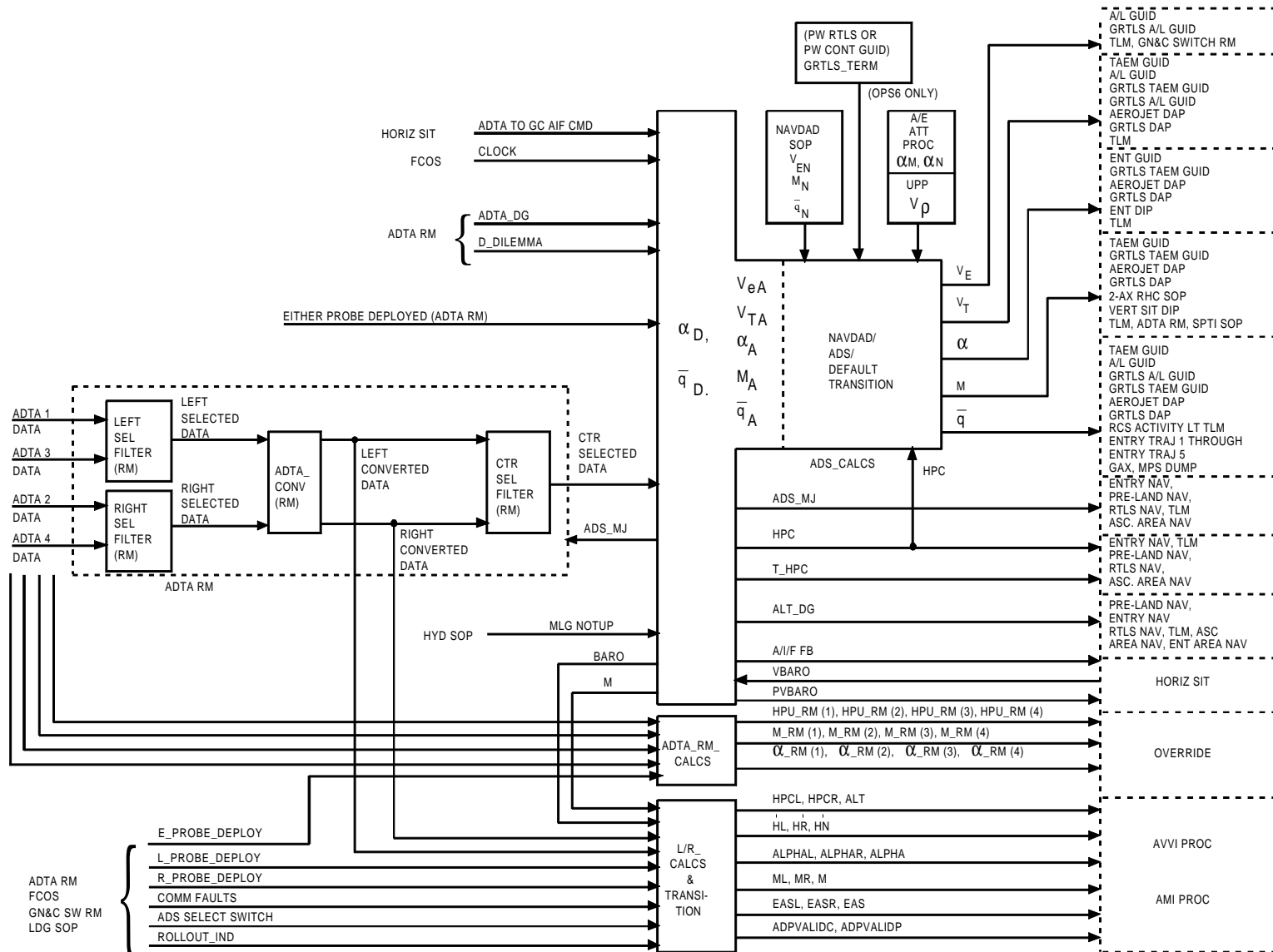


FIGURE 4.39-1. Air Data System Functional Block Diagram

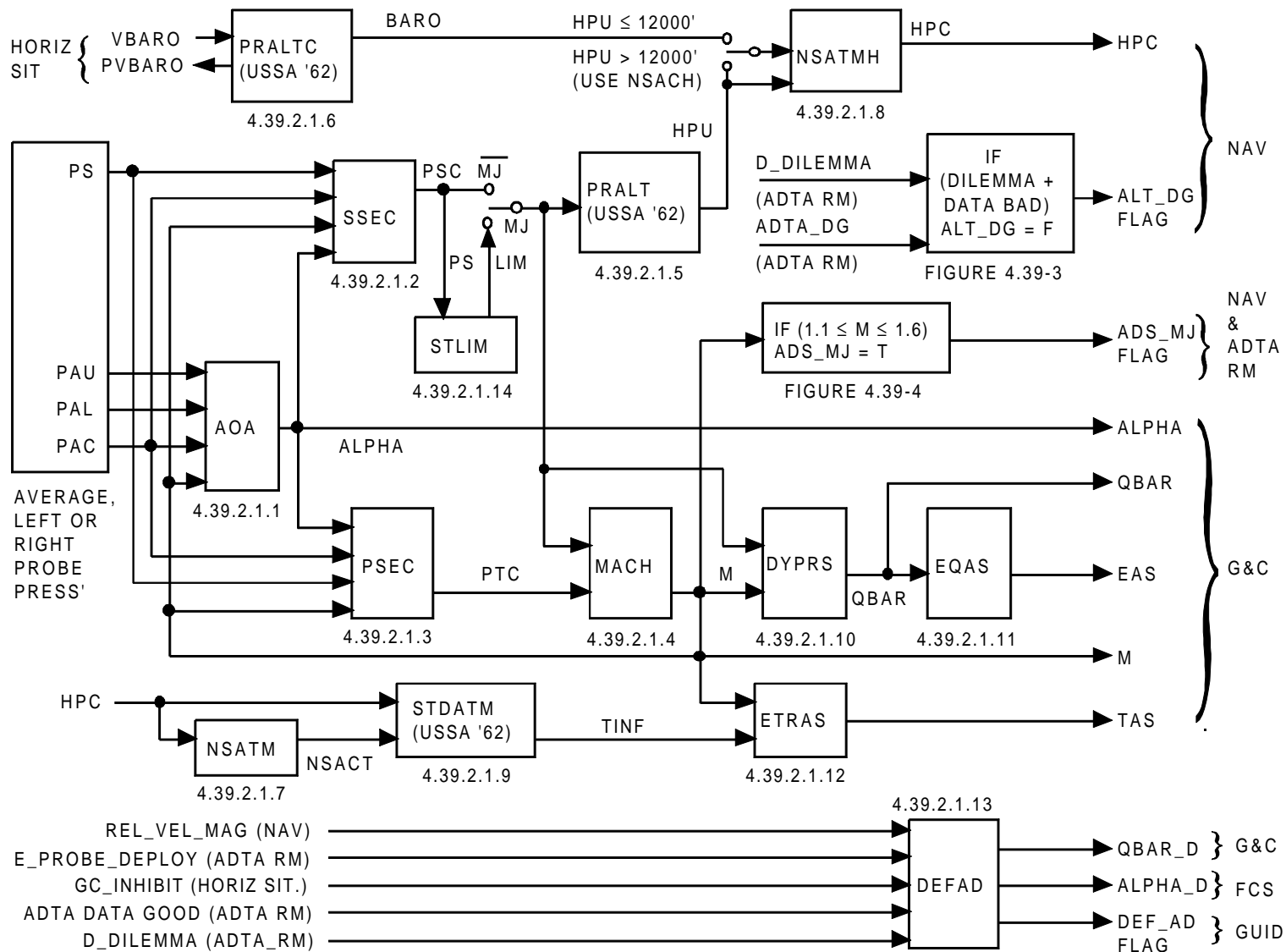


FIGURE 4.39-2. ADS Air Data Calculation Block Diagram, OPS 3

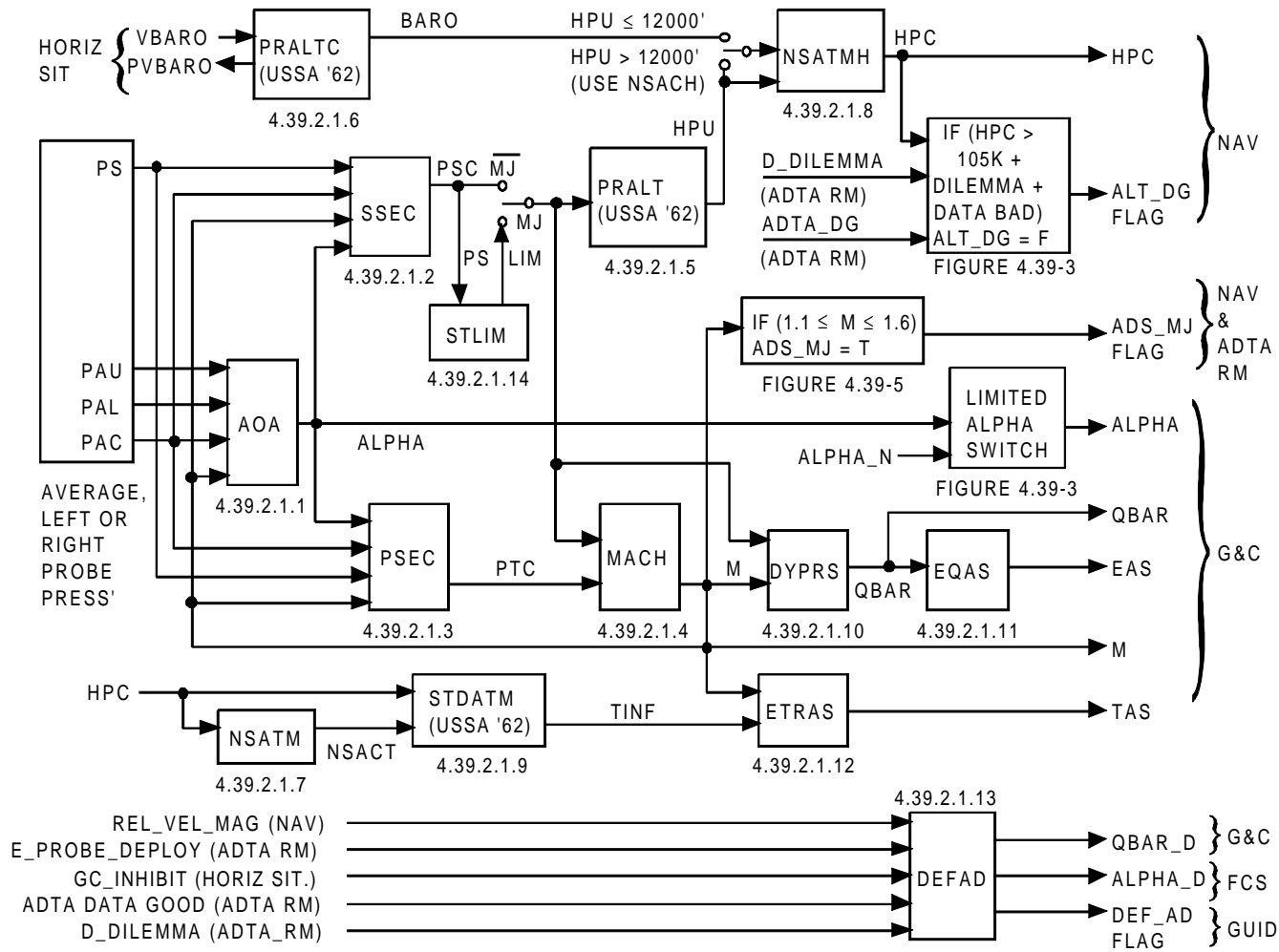


FIGURE 4.39-3. ADS Air Data Calculation Block Diagram, OPS 6

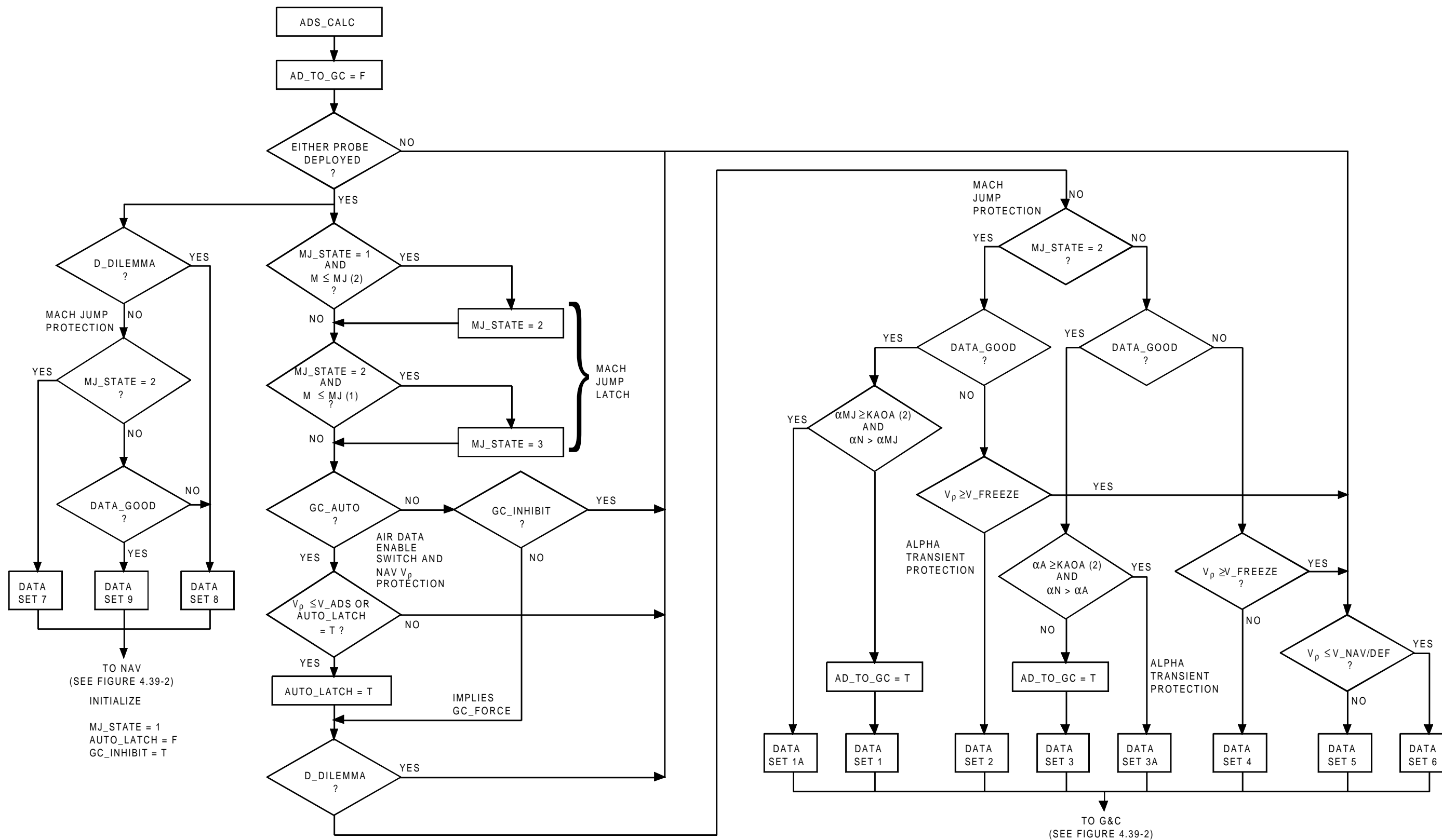


FIGURE 4.39-4. OPS 3 GN&C Transition Logic Requirements

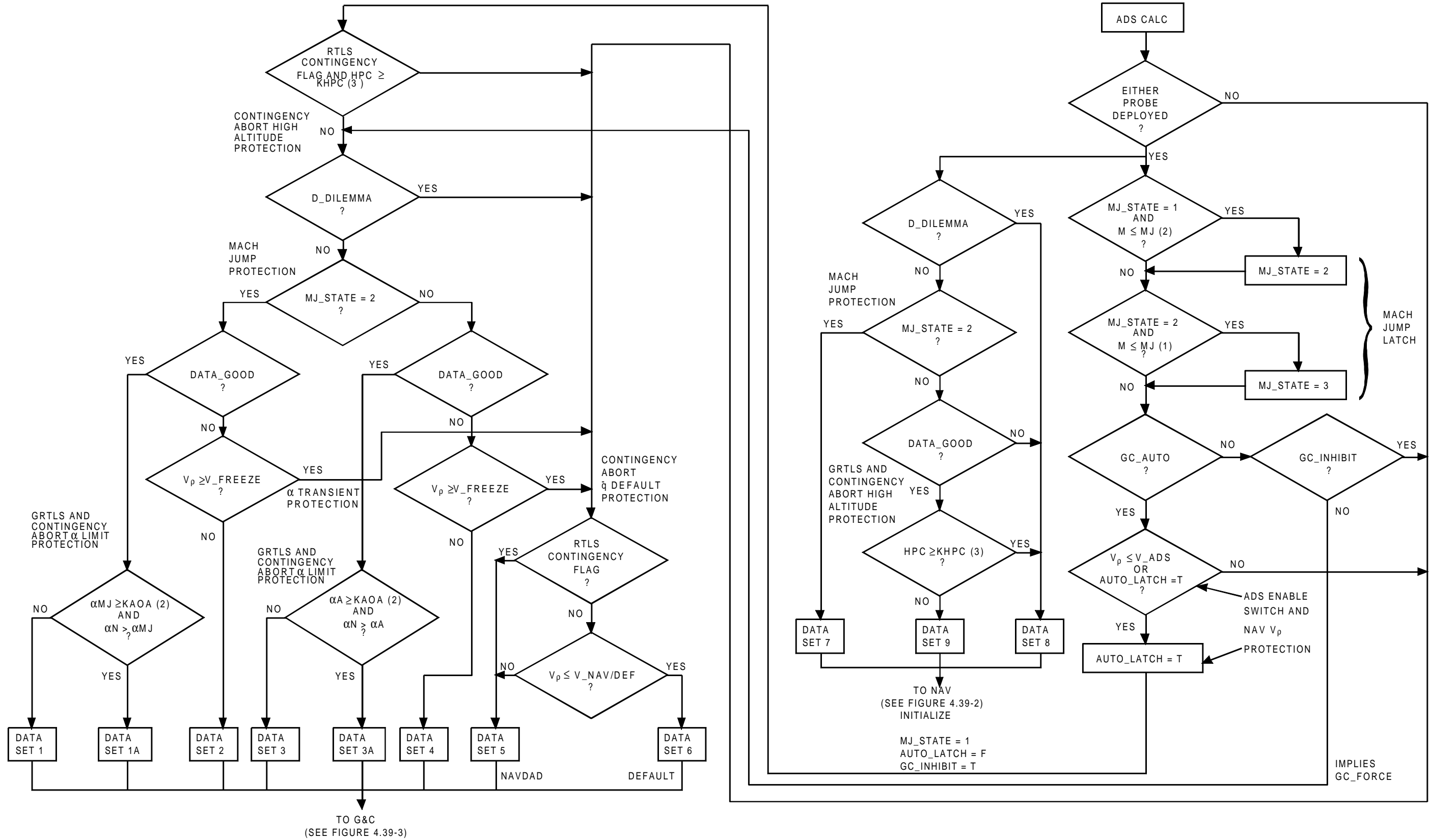


FIGURE 4.39-5. OPS 6 GN&C Transition Logic Requirements

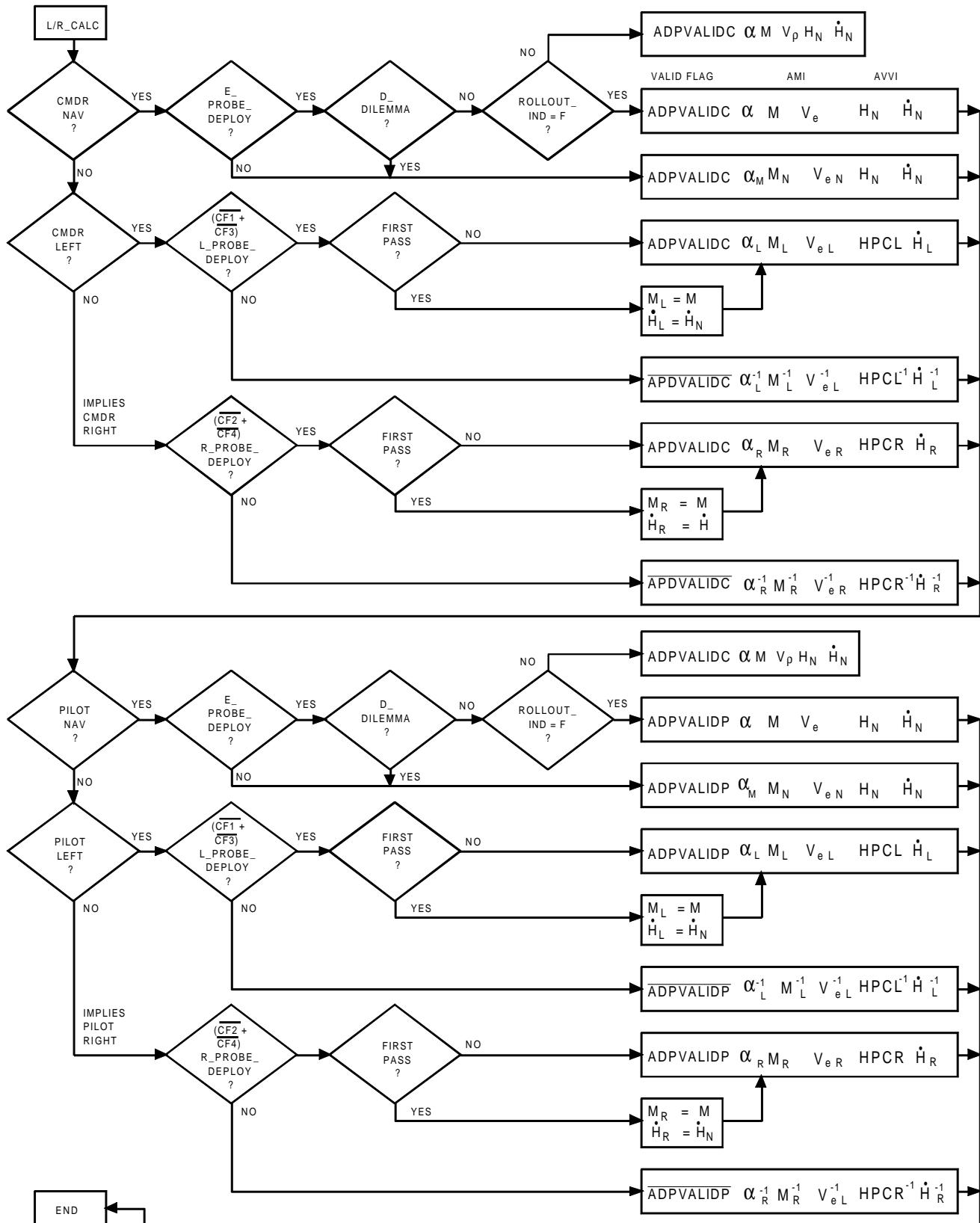


FIGURE 4.39-6. Left/NAV/Right Display Logic Requirements

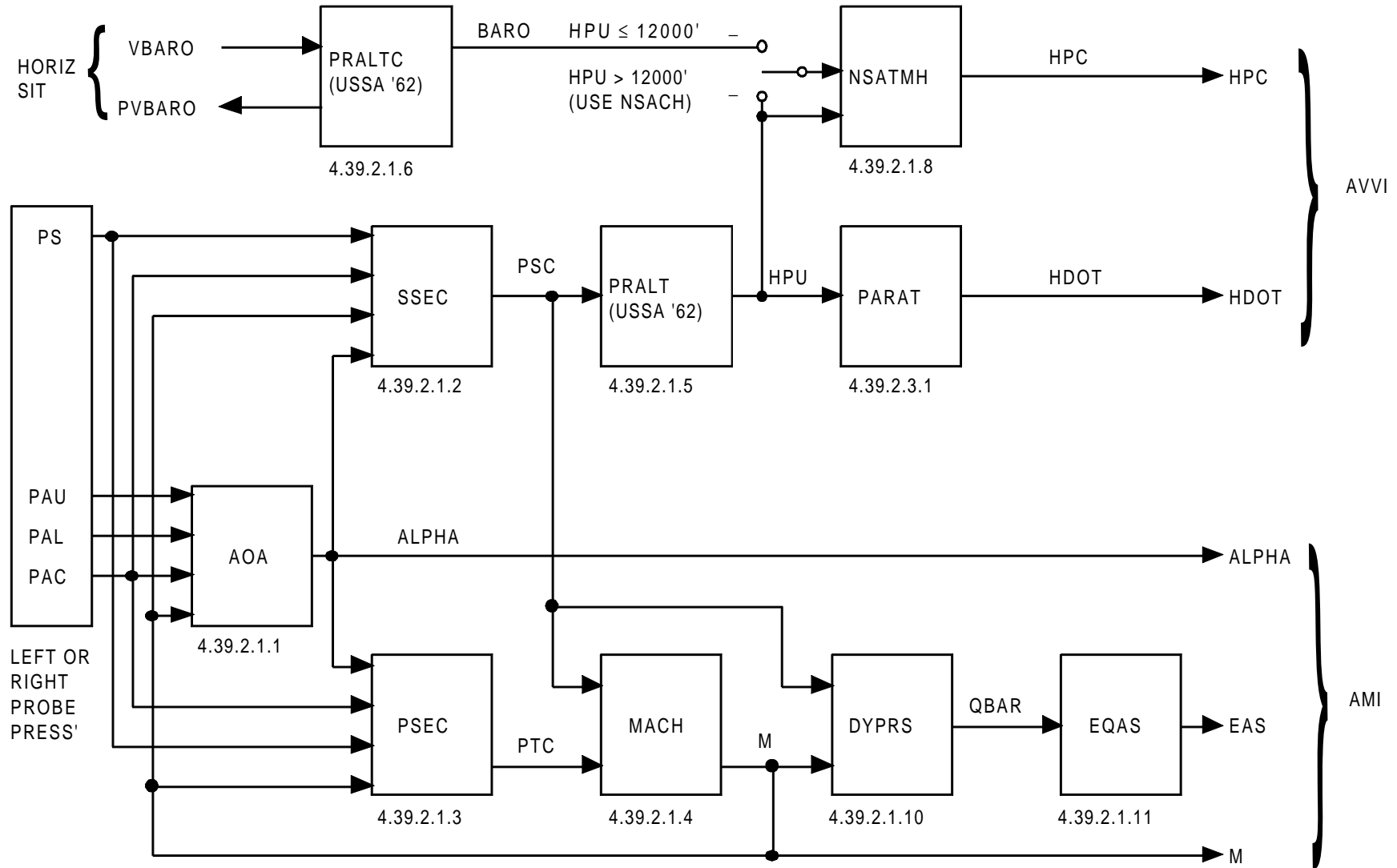


FIGURE 4.39-7. Left/Right Air Data Calculation Block Diagram (OPS 3 and 6)

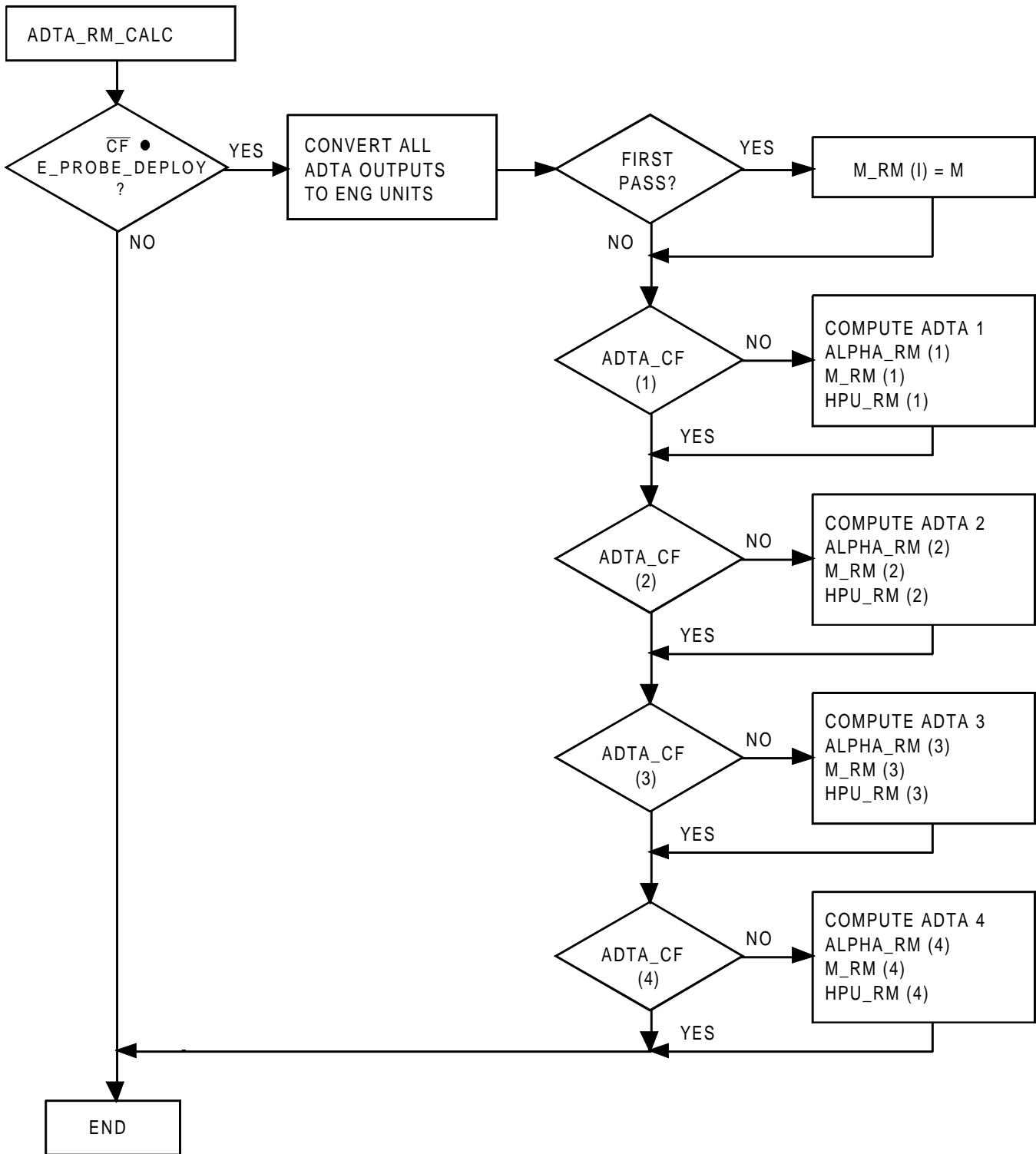


FIGURE 4.39-8. ADS RM Calculation Logic Requirements

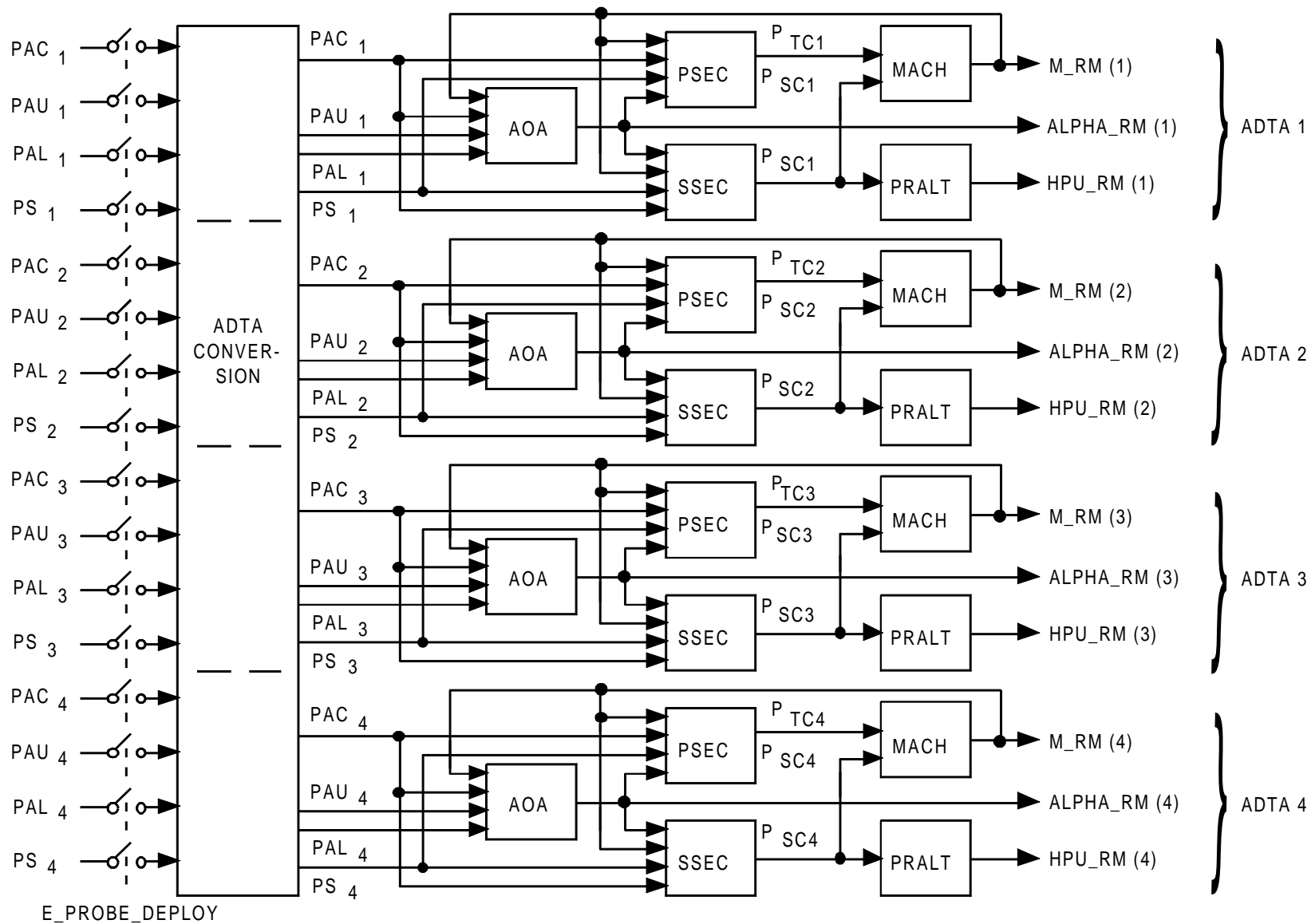


FIGURE 4.39-9. ADTA RM Air Data Calculations Block Diagram

TABLE 4.39-2. INPUT FUNCTIONAL PARAMETERS FOR AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------------------|------------|-----------------------------------|--------|-----------------|-----------|---------|---------|-------|
| ADTAM(1,2) | V71P7040B | ADTA 1 STATIC PRESS | WD2 | ADTA 1 | COUNTS | HXS | 93017G | * |
| ADTAM(1,3) | V71P7080B | ADTA 1 CTR ALPHA PRESS(PAC) | WD3 | ADTA 1 | COUNTS | HXS | 93017G | * |
| ADTAM(1,5) | V71P7120B | ADTA 1 LWR ALPHA PRESS(PAL) | WD5 | ADTA 1 | COUNTS | HXS | 93017G | * |
| ADTAM(1,6) | V71P7140B | ADTA 1 UPR ALPHA PRESS(PAU) | WD6 | ADTA 1 | COUNTS | HXS | 93017G | * |
| ADTAM(2,2) | V71P7540B | ADTA 2 STATIC PRESS | WD2 | ADTA 2 | COUNTS | HXS | 93017G | * |
| ADTAM(2,3) | V71P7580B | ADTA 2 CTR ALPHA PRESS(PAC) | WD3 | ADTA 2 | COUNTS | HXS | 93017G | * |
| ADTAM(2,5) | V71P7620B | ADTA 2 LWR ALPHA PRESS(PAL) | WD5 | ADTA 2 | COUNTS | HXS | 93017G | * |
| ADTAM(2,6) | V71P7640B | ADTA 2 UPR ALPHA PRESS(PAU) | WD6 | ADTA 2 | COUNTS | HXS | 93017G | * |
| ADTAM(3,2) | V71P8040B | ADTA 3 STATIC PRESS | WD2 | ADTA 3 | COUNTS | HXS | 93017G | * |
| ADTAM(3,3) | V71P8080B | ADTA 3 CTR ALPHA PRESS(PAC) | WD3 | ADTA 3 | COUNTS | HXS | 93017G | * |
| ADTAM(3,5) | V71P8120B | ADTA 3 LWR ALPHA PRESS(PAL) | WD5 | ADTA 3 | COUNTS | HXS | 93017G | * |
| ADTAM(3,6) | V71P8140B | ADTA 3 UPR ALPHA PRESS(PAU) | WD6 | ADTA 3 | COUNTS | HXS | 93017G | * |
| ADTAM(4,2) | V71P8540B | ADTA 4 STATIC PRESS | WD2 | ADTA 4 | COUNTS | HXS | 93017G | * |
| ADTAM(4,3) | V71P8580B | ADTA 4 CTR ALPHA PRESS(PAC) | WD3 | ADTA 4 | COUNTS | HXS | 93017G | * |
| ADTAM(4,5) | V71P8620B | ADTA 4 LWR ALPHA PRESS(PAL) | WD5 | ADTA 4 | COUNTS | HXS | 93017G | * |
| ADTAM(4,6) | V71P8640B | ADTA 4 UPR ALPHA PRESS(PAU) | WD6 | ADTA 4 | COUNTS | HXS | 93017G | * |
| ADTA_CF(1) | V91X3300X | ADTA 1 COMMFAULT | | FCOS | | | | |
| ADTA_CF(2) | V91X3330X | ADTA 2 COMMFAULT | | FCOS | | | | |
| ADTA_CF(3) | V91X3360X | ADTA 3 COMMFAULT | | FCOS | | | | |
| ADTA_CF(4) | V91X3390X | ADTA 4 COMMFAULT | | FCOS | | | | |
| AIR_DATA_AIF | V93J5014C | ADTA TO G&C A/I/F CMD | | HORIZ SIT DISP | | HXS | 93017G | * |
| ALPHA_N | V90H2246C | NAV DERIVED ANGLE OF ATTACK | | A/E ATT PROC | DEG | SPL | 93017G | * |
| ALT | V95H0175CA | CURR ORB ALT ABOVE REF ELLIPSOID | | RTLS UPP | | SPL | 93017G | * |
| ALT | V95H0175CC | CURR ORB ALT ABOVE REF ELLIPSOID | | ENT UPP | FT | SPL | 93017G | * |
| ALT | V95H0175CD | CURR ORB ALT ABOVE REF ELLIPSOID | | TAEM UPP | FT | SPL | 93017G | * |
| ALT | V95H0175CE | CURR ORB ALT ABOVE REF ELLIPSOID | | A/L UPP | FT | SPL | 93017G | * |
| BARO | V93H5005C | ALT SET TO FLD PRESS CORR TO MSL | | HORIZ SIT DISP | INHG | VAR | | |
| BARO_DATA_GOOD | V90X5180X | ADTA DATA GOOD | | ADTA RM | | BD | 93017G | * |
| CLOCK/CLOCKTIME | V91W5000C | CLOCK-COMPUTER(GMT) | | FCOS | S | | 93160B | * |
| D_DILEMMA | V90X4840X | DELAYED ADTA DILEMA FLAG | | ADTA RM | | BD | 93017G | * |
| EAS_N | V95L3175C | NAV DERIVED EQUIVALENT AIRSPEED | | NAVDAD SOP | FT/S | SPL | 93017G | * |
| E_PROBE_DEPLOY | V90X4877X | EITHER PROBE DEPLOYED | | ADTA RM | | BD | 93017G | * |
| GLIDE_RTLS_INHIBIT | V90X2090XA | RTLS CONTINGENCY FLAG | | PW RTLS GUID | | BD | 93017G | * |
| GLIDE_RTLS_INHIBIT | V90X2090XB | RTLS CONTINGENCY FLAG | | MSC | | BD | 93090E | |
| GLIDE_RTLS_INHIBIT | V90X2090XC | RTLS CONTINGENCY FLAG | | PW CONT GUID | | BD | 93017G | * |
| GLIDE_RTLS_INHIBIT | V90X2090XD | RTLS CONTINGENCY FLAG | | CONT 3E/O GUID | | BD | 93017G | * |
| GLIDE_RTLS_INHIBIT | V90X2090XE | RTLS CONTINGENCY FLAG | | GRTLS TAEM GUID | | BD | 93017G | * |
| H_DOT_ELLIPSOID/H_DOT | V95L0265CA | EST ALTITUDE RATE | | RTLS UPP | FT/S | SPL | 93017G | * |
| H_DOT_ELLIPSOID/H_DOT | V95L0265CB | EST ALTITUDE RATE | | TAEM UPP | FT/S | SPL | 93017G | * |
| H_DOT_ELLIPSOID/H_DOT | V95L0265CC | EST ALTITUDE RATE | | A/L UPP | FT/S | SPL | 93017G | * |
| H_DOT_ELLIPSOID/H_DOT | V95L0265CD | EST ALTITUDE RATE | | ENT UPP | FT/S | SPL | 93017G | * |
| LADS | V96J2171C | SELECTED LEFT AIR DATA SELECT POS | | GN&C SW RM | | HXS | 93017G | * |
| L_PROBE_DEPLOY | V90X4870X | LEFT PROBE DEPLOYED FLAG | | ADTA RM | | BD | 93017G | * |
| MEDS_ALPHA | V90H3908C | ANGLE OF ATTACK FOR MEDS | | A/E ATT PROC | | | 92619A | |
| MLY_GEAR_NOTUP | V90X7500X | LANDING GEAR RELEASED | | HYD SYS SOP | | | | |
| M_N | V90L0847C | NAV DERIVED MACH NUMBER | | NAVDAD SOP | | SPL | 93017G | * |

TABLE 4.39-2. INPUT FUNCTIONAL PARAMETERS FOR AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|----------------|------------|------------------------------------|-------------|--------|--------------|------------------|---------|-------------|
| PAC | V90P4711C | CENTER SELECTED ADTA PAC | ADTA RM | INHG | SPL | | 93017G | * |
| PACL | V90P4811C | LEFT SELECTED ADTA PAC | ADTA RM | INHG | | | | |
| PACR | V90P4911C | RIGHT SELECTED ADTA PAC | ADTA RM | INHG | | | | |
| PAL | V90P4712C | CENTER SELECTED ADTA PAL | ADTA RM | INHG | SPL | | 93017G | * |
| PALL | V90P4812C | LEFT SELECTED ADTA PAL | ADTA RM | INHG | | | | |
| PALR | V90P4912C | RIGHT SELECTED ADTA PAL | ADTA RM | INHG | | | | |
| PAU | V90P4710C | CENTER SELECTED ADTA PAU | ADTA RM | INHG | SPL | | 93017G | * |
| PAUL | V90P4810C | LEFT SELECTED ADTA PAU | ADTA RM | INHG | | | | |
| PAUR | V90P4910C | RIGHT SELECTED ADTA PAU | ADTA RM | INHG | | | | |
| PS | V90P4706C | CENTER SELECTED ADTA PS | ADTA RM | INHG | SPL | | 93017G | * |
| PSL | V90P4806C | LEFT SELECTED ADTA PS | ADTA RM | INHG | | | | |
| PSR | V90P4906C | RIGHT SELECTED ADTA PS | ADTA RM | INHG | | | | |
| QBAR_N | V95P3170C | NAV DERIVED DYNAMIC PRESSURE | NAVDAD SOP | LB/FT2 | SPL | | 93017G | * |
| RADS | V96J2271C | SELECTED RIGHT AIR DATA SELECT POS | GN&C SW RM | | HXS | | 93017G | * |
| REL_VEL_MAG | V95L0151CA | GND REL VEL MAGNITUDE IN M50 SYS | RTLS UPP | FT/S | SPL | | 93017G | * |
| REL_VEL_MAG/V | V95L0151CB | GND REL VEL MAGNITUDE IN M50 SYS | A/L UPP | FT/S | SPL | | 93017G | * |
| REL_VEL_MAG/V | V95L0151CC | GND REL VEL MAGNITUDE IN M50 SYS | ENT UPP | FT/S | SPL | | 93017G | * |
| REL_VEL_MAG/V | V95L0151CD | GND REL VEL MAGNITUDE IN M50 SYS | TAEM UPP | FT/S | SPL | | 93017G | * |
| ROLLOUT_IND | V96X0052X | ROLLOUT FLAG | LANDING SOP | | | | 90102D | |
| R_PROBE_DEPLOY | V90X4871X | RIGHT PROBE DEPLOYED FLAG | ADTA RM | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.39-3. OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-------------|-----------|-----------------------------------|---|-------|-----------|---------|---------|-------|
| ADPVALIDC | V95X3115X | CMDR AIR DATA PARM VALIDITY FLAG | AMI PROC AVVI PROC | | | | | |
| ADPVALIDP | V95X3117X | PILOT AIR DATA PARM VALIDITY FLAG | AMI PROC AVVI PROC | | | | | |
| ADS_FLAG | V95X3110X | ADS CALCULATION FLAG | DL FMT 21/1 DL FMT 23/1 | | BD | | 93017G | * |
| ADS_MJ | V95X3112X | ADS MACH JUMP FLAG | ADTA RM ASC AREA NAV DL FMT 21/1 DL FMT 23/1 ENT NAV GPS SOP PRELAND NAV RTLS NAV | | BD | | 93017G | * |
| ALPHA | V95H3021C | GN&C ANGLE OF ATTACK | AEROJET DAP DL FMT 21/1 DL FMT 23/A ENT DIP ENT GUID GRTLS DAP GRTLS TAEM GUID TAEM GUID | DEG | SPL | | 93017G | * |
| ALPHA_RM(1) | V95H3186C | ADTA 1 ALPHA INDICATION | DL FMT 23/1 OVERRIDE DISP | DEG | SPL | | 93017G | * |
| ALPHA_RM(2) | V95H3187C | ADTA 2 ALPHA INDICATION | DL FMT 23/1 OVERRIDE DISP | DEG | SPL | | 93017G | * |
| ALPHA_RM(3) | V95H3188C | ADTA 3 ALPHA INDICATION | DL FMT 23/1 OVERRIDE DISP | DEG | SPL | | 93017G | * |
| ALPHA_RM(4) | V95H3189C | ADTA 4 ALPHA INDICATION | DL FMT 23/1 OVERRIDE DISP | DEG | SPL | | 93017G | * |
| ALT_DG | V95X3111X | PRESSURE ALTITUDE DATA GOOD FLAG | ASC AREA NAV DL FMT 21/1 DL FMT 23/1 ENT AREA NAV ENT NAV GPS SOP PRELAND NAV RTLS NAV | | BD | | 93017G | * |
| DDALPHAC | V95H3105C | CMDR ANGLE OF ATTACK DISPLAY | AMI PROC | DEG | | | | |
| DDALPHAP | V95H3107C | PILOT ANGLE OF ATTACK DISPLAY | AMI PROC | DEG | | | | |
| DDALTC | V95H3142C | CMDR ALTITUDE DISPLAY | AVVI PROC | KFT | | | | |
| DDALTP | V95H3144C | PILOT ALTITUDE DISPLAY | AVVI PROC | KFT | | | | |
| DDEASC | V95L3141C | CMDR EQUIVALENT AIRSPEED DISPLAY | AMI PROC E/L EV AN PROC | FT/S | | | | |
| DDEASP | V95L3143C | PILOT EQUIVALENT AIRSPEED DISPLAY | AMI PROC | FT/S | | | | |

TABLE 4.39-3. OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-------------|-----------|-----------------------------------|--|-------|-----------|---------|---------|-------|
| DDHDOTC | V95L3133C | CMDR PRESS ALTITUDE RATE DISPLAY | AVVI PROC TLM | FT/S | SPL | | | |
| DDHDOTP | V95L3135C | PILOT PRESS ALTITUDE RATE DISPLAY | AVVI PROC TLM | FT/S | SPL | | | |
| DDMC | V95L3101C | CMDR MACH NUMBER DISPLAY | AMI PROC | | | | | |
| DDMP | V95L3103C | PILOT MACH NUMBER DISPLAY | AMI PROC | | | | | |
| DEF_AD | V95X3148X | DEFAULT AIR DATA FLAG | DL FMT 23/3 GRTLS TAEM GUID TAEM GUID | | BD | | 93017G | * |
| EAS | V95L3145C | GN&C EQUIVALENT AIRSPEED | A/L GUID AEROJET DAP DL FMT 21/1 DL FMT 23/1 GN&C SW RM GRTLS A/L GUID GRTLS DAP HUD PROC | FT/S | SPL | | 93017G | * |
| GC_A/I/F_FB | V95J3138C | ADTA TO GC A/I/F FEEDBACK | MEDS FC GNC XFER | | VAR | | 92571B | |
| HPC | V95H3001C | ADS CORRECTED PRESSURE ALTITUDE | ASC AREA NAV DL FMT 21/1 DL FMT 23/A ENT AREA NAV ENT NAV GPS SOP PRELAND NAV RTLS NAV | FT | SPL | | 93017G | * |
| HPU_RM(1) | V95H3193C | ADTA 1 ALT INDICATION | DL FMT 23/1 OVERRIDE DISP | KFT | SPL | | 93017G | * |
| HPU_RM(2) | V95H3194C | ADTA 2 ALT INDICATION | DL FMT 23/1 OVERRIDE DISP | KFT | SPL | | 93017G | * |
| HPU_RM(3) | V95H3195C | ADTA 3 ALT INDICATION | DL FMT 23/1 OVERRIDE DISP | KFT | SPL | | 93017G | * |
| HPU_RM(4) | V95H3196C | ADTA 4 ALT INDICATION | DL FMT 23/1 OVERRIDE DISP | KFT | SPL | | 93017G | * |

TABLE 4.39-3. OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|------------------------------------|---|-------|-----------|---------|---------|-------|
| M/MACH | V95L3029C | GN&C MACH NUMBER | 2-AX RHC SOP ADTA RM AEROJET DAP ASC AREA NAV DL FMT 21/1 DL FMT 23/A E/L EV AN PROC ENT AREA NAV ENT BRG SPEC GRTLS DAP GRTLS TAEM GUID MEDS FC GNC XFER MSC PTI SPTI SOP TAEM GUID VERT SIT DIP | | SPL | | 93017G | * |
| M_RM(1) | V95L3180C | ADTA 1 MACH INDICATION | DL FMT 23/1 OVERRIDE DISP | | SPL | | 93017G | * |
| M_RM(2) | V95L3181C | ADTA 2 MACH INDICATION | DL FMT 23/1 OVERRIDE DISP | | SPL | | 93017G | * |
| M_RM(3) | V95L3182C | ADTA 3 MACH INDICATION | DL FMT 23/1 OVERRIDE DISP | | SPL | | 93017G | * |
| M_RM(4) | V95L3183C | ADTA 4 MACH INDICATION | DL FMT 23/1 OVERRIDE DISP | | SPL | | 93017G | * |
| NSACH | V95H3002C | NON-STND ALTITUDE CORRECTION TERM | DL FMT 23/1 | FT | SPL | | 93017G | * |
| PSC | V95P3211C | ADS CORRECTED STATIC PRESS | DL FMT 23/1 | INHG | SPL | | 93017G | * |
| PSLIM | V95P3162C | LIMITED CORRECTED STATIC AIR PRESS | DL FMT 23/1 | INHG | SPL | | 93017G | * |
| PTC | V95P3201C | ADS CORRECTED TOTAL PRESS | DL FMT 23/A | INHG | SPL | | 93017G | * |
| PVBARO | V95P3403C | PREVIOUS BAROMETRIC CORRECTION | DL FMT 23/A HORIZ SIT DISP | INHG | SPL | | 93017G | * |

TABLE 4.39-3. OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|--------------|------------|----------------------------------|---|---------|-----------|---------|---------|-------|
| QBAR/QBAR_AD | V95P3011C | GN&C DYNAMIC PRESSURE | A/L GUID AEROJET DAP DL FMT 21/A DL FMT 23/A ENTRY TRAJ1 ENTRY TRAJ2 ENTRY TRAJ3 ENTRY TRAJ4 ENTRY TRAJ5 GAX GRTLS A/L GUID GRTLS DAP GRTLS TAEM GUID MPS DUMP PTI RCS ACT LT TAEM GUID | LBF/FT2 | SPL | | 93017G | * |
| TAS | V95L3015C | GN&C TRUE AIRSPEED | A/L GUID AEROJET DAP DL FMT 21/1 DL FMT 23/A GRTLS A/L GUID GRTLS DAP GRTLS TAEM GUID | FT/S | SPL | | 93017G | * |
| TINF | V95T3161C | EST FREE-STREAM STATIC AIR TEMP | DL FMT 23/1 | DEGK | SPL | | 93017G | * |
| T_HPC | V95W3400C | ADS CORRECTED PRESS ALT TIME TAG | ASC AREA NAV DL FMT 23/A ENT NAV GPS SOP PRELAND NAV RTLS NAV | S | DPL | | 93017G | * |
| | V90M2857PD | CGEB_IPA_LG2_FLAG_WD1_HFE | DL FMT 23/3 | | | | 93017G | * |
| | V95M2857P | CGYB_ADS_MJ_HFE | DL FMT 21/1 DL FMT 23/1 | | | | 93017G | * |
| | V95M2858P | CGPB_BARO_DG_HFE | DL FMT 21/1 DL FMT 23/1 | | | | 93017G | * |
| | V95M2859P | CGYB_MC163_HFE_FLAGWD | DL FMT 21/1 DL FMT 23/1 | | | | 93017G | * |

TABLE 4.39-3. OUTPUT FUNCTIONAL PARAMETERS FROM AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|--------|--------------|-------------|-------|-----------|------------------|---------|-------------|
|-----------|--------|--------------|-------------|-------|-----------|------------------|---------|-------------|

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
 (HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|---------------|-----------|------------|----|----|---|---|---------|----|-----|---------|-------------|
| ABIAS(1) | V98U9530C | DEG | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| ABIAS(2) | V98U9531C | DEG | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| ASLOPE(1) | V98U9528C | DEG/FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| ASLOPE(2) | V98U9529C | DEG/FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| HBIAS_ADTA(1) | V98U9485C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HBIAS_ADTA(2) | V98U9486C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HBIAS_ADTA(3) | V98U9487C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HBIAS_ADTA(4) | V98U9488C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HBIAS_ADTA(5) | V98U9489C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HBIAS_ADTA(6) | V98U9490C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(1) | V98U9479C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(2) | V98U9480C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(3) | V98U9481C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(4) | V98U9482C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(5) | V98U9483C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| HSLOPE(6) | V98U9484C | ND | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| KA(1,1) | V97U3763C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,10) | V97U3799C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,11) | V97U3803C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,12) | V97U3807C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,2) | V97U3767C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,3) | V97U3771C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,4) | V97U3775C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,5) | V97U3779C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,6) | V97U3783C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,7) | V97U3787C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,8) | V97U3791C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(1,9) | V97U3795C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,03) | V97U3772C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,1) | V97U3764C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,10) | V97U3800C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,11) | V97U3804C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,12) | V97U3808C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,2) | V97U3768C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,4) | V97U3776C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,5) | V97U3780C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,6) | V97U3784C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,7) | V97U3788C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,8) | V97U3792C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(2,9) | V97U3796C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,03) | V97U3773C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,1) | V97U3765C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,10) | V97U3801C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,11) | V97U3805C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,12) | V97U3809C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,2) | V97U3769C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,4) | V97U3777C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| KA(3,5) | V97U3781C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,6) | V97U3785C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,7) | V97U3789C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,8) | V97U3793C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(3,9) | V97U3797C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,01) | V97U3766C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,02) | V97U3770C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,03) | V97U3774C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,10) | V97U3802C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,11) | V97U3806C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,12) | V97U3810C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,4) | V97U3778C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,5) | V97U3782C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,6) | V97U3786C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,7) | V97U3790C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,8) | V97U3794C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KA(4,9) | V97U3798C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KAOA(2) | V98U9536C | DEG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KHPC(1) | V98U9542C | FT | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KHPC(3) | V98U9544C | FT | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KLIMP | V96U9382C | ND | F | S | M | X | G4.39 | 00 | ZSK | DC0599 | |
| KMACH(2) | V97U3527C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,01) | V97U3326C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,02) | V97U3331C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,03) | V97U3336C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,04) | V97U3341C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,05) | V97U3346C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,06) | V97U3351C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,07) | V97U3356C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,08) | V97U3361C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,09) | V97U3366C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,10) | V97U3371C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,11) | V97U3376C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,12) | V97U3381C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,13) | V97U3386C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,14) | V97U3391C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,15) | V97U3396C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(1,16) | V98U9433C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,01) | V97U3327C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,02) | V97U3332C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,03) | V97U3337C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,04) | V97U3342C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,05) | V97U3347C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,06) | V97U3352C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,07) | V97U3357C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,08) | V97U3362C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,09) | V97U3367C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| KP(2,10) | V97U3372C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,11) | V97U3377C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,12) | V97U3382C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,13) | V97U3387C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,14) | V97U3392C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,15) | V97U3397C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(2,16) | V98U9434C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,01) | V97U3328C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,02) | V97U3333C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,03) | V97U3338C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,04) | V97U3343C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,05) | V97U3348C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,06) | V97U3353C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,07) | V97U3358C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,08) | V97U3363C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,09) | V97U3368C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,10) | V97U3373C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,11) | V97U3378C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,12) | V97U3383C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,13) | V97U3388C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,14) | V97U3393C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,15) | V97U3398C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(3,16) | V98U7924C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,01) | V97U3329C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,02) | V97U3334C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,03) | V97U3339C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,04) | V97U3344C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,05) | V97U3349C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,06) | V97U3354C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,07) | V97U3359C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,08) | V97U3364C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,09) | V97U3369C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,10) | V97U3374C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,11) | V97U3379C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,12) | V97U3384C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,13) | V97U3389C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,14) | V97U3394C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,15) | V97U3399C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(4,16) | V98U9436C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,01) | V97U3330C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,02) | V97U3335C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,03) | V97U3340C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,04) | V97U3345C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,05) | V97U3350C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,06) | V97U3355C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,07) | V97U3360C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,08) | V97U3365C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| KP(5,09) | V97U3370C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,10) | V97U3375C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,11) | V97U3380C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,12) | V97U3385C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,13) | V97U3390C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,14) | V97U3395C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,15) | V98U9432C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KP(5,16) | V98U9437C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KPSC(1) | V98U9538C | IN-HG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KPTC(1) | V98U9540C | IN-HG | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,01) | V97U3818C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,02) | V97U3823C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,03) | V97U3828C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,04) | V97U3833C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,05) | V97U3838C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,06) | V97U3843C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,07) | V97U3848C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,08) | V97U3853C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,09) | V97U3858C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,10) | V97U3863C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,11) | V97U3868C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,12) | V97U3873C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,13) | V97U3878C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,14) | V97U3883C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,15) | V97U3888C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,16) | V97U3893C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,17) | V97U3898C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,18) | V97U3303C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(1,19) | V97U3308C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,01) | V97U3819C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,02) | V97U3824C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,03) | V97U3829C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,04) | V97U3834C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,05) | V97U3839C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,06) | V97U3844C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,07) | V97U3849C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,08) | V97U3854C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,09) | V97U3859C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,10) | V97U3864C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,11) | V97U3869C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,12) | V97U3874C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,13) | V97U3879C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,14) | V97U3884C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,15) | V97U3889C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,16) | V97U3894C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,17) | V97U3899C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(2,18) | V97U3304C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| KS(2,19) | V97U3309C | DEG**-1 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,01) | V97U3820C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,02) | V97U3825C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,03) | V97U3830C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,04) | V97U3835C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,05) | V97U3840C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,06) | V97U3845C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,07) | V97U3850C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,08) | V97U3855C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,09) | V97U3860C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,10) | V97U3865C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,11) | V97U3870C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,12) | V97U3875C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,13) | V97U3880C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,14) | V97U3885C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,15) | V97U3890C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,16) | V97U3895C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,17) | V97U3300C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,18) | V97U3305C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(3,19) | V97U3310C | DEG**-2 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,01) | V97U3821C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,02) | V97U3826C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,03) | V97U3831C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,04) | V97U3836C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,05) | V97U3841C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,06) | V97U3846C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,07) | V97U3851C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,08) | V97U3856C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,09) | V97U3861C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,10) | V97U3866C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,11) | V97U3871C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,12) | V97U3876C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,13) | V97U3881C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,14) | V97U3886C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,15) | V97U3891C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,16) | V97U3896C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,17) | V97U3301C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,18) | V97U3306C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(4,19) | V97U3311C | DEG**-3 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,01) | V97U3822C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,02) | V97U3827C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,03) | V97U3832C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,04) | V97U3837C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,05) | V97U3842C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,06) | V97U3847C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,07) | V97U3852C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,08) | V97U3857C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|------------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| KS(5,09) | V97U3862C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,10) | V97U3867C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,11) | V97U3872C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,12) | V97U3877C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,13) | V97U3882C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,14) | V97U3887C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,15) | V97U3892C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,16) | V97U3897C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,17) | V97U3302C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,18) | V97U3307C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KS(5,19) | V97U3312C | DEG**-4 | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| KVT(2) | V97U3719C | FT/SEC | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(03) | V97U3754C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(04) | V97U3755C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(05) | V97U3756C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(06) | V97U3757C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(07) | V97U3758C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(08) | V97U3759C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(09) | V97U3760C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(1) | V97U3722C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(10) | V97U3761C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(11) | V97U3762C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_AOA(2) | V97U3723C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(03) | V97U3313C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(04) | V97U3314C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(05) | V97U3315C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(06) | V97U3316C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(07) | V97U3317C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(08) | V97U3318C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(09) | V97U3319C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(1) | V97U3724C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(10) | V97U3320C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(11) | V97U3321C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(12) | V97U3322C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(13) | V97U3323C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(14) | V97U3324C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(15) | V97U3325C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_PT(2) | V97U3725C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(01) | V97U3726C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(02) | V97U3727C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(03) | V97U3728C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(04) | V97U3729C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(05) | V97U3730C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(06) | V97U3731C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(07) | V97U3732C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(08) | V97U3733C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(09) | V97U3734C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|---------------------|----|----|---|---|---------|----|-----|---------|-------------|
| MB_SP(10) | V97U3735C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(11) | V97U3736C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(12) | V97U3811C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(13) | V97U3812C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(14) | V97U3813C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(15) | V97U3814C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(16) | V97U3815C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(17) | V97U3816C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MB_SP(18) | V97U3817C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MJ(1) | V98U9551C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| MJ(2) | V98U9552C | ND | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| M_G | V96U8446C | ND | F | S | D | P | G4.39 | 01 | ZFK | DC0599 | |
| | | | | | | | | 03 | ZFK | | |
| PALT(1) | V98U9491C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(2) | V98U9492C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(3) | V98U9493C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(4) | V98U9494C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(5) | V98U9495C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(6) | V98U9496C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| PALT(7) | V98U9497C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| QBAR_G | V96U8447C | LBS/FT**2 | F | S | D | P | G4.39 | 01 | ZFK | DC0599 | |
| | | | | | | | | 03 | ZFK | | |
| QBIAS(1) | V98U9507C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(2) | V98U9508C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(3) | V98U9509C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(4) | V98U9510C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(5) | V98U9511C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(6) | V98U9512C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(7) | V98U9513C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(8) | V98U9514C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QBIAS(9) | V98U9515C | LB/FT**2 | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(1) | V98U9498C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(2) | V98U9499C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(3) | V98U9500C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(4) | V98U9501C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(5) | V98U9502C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(6) | V98U9503C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(7) | V98U9504C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(8) | V98U9505C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| QSLOPE(9) | V98U9506C | (LB/FT**2)/(FT/SEC) | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(1) | V98U9516C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(10) | V98U9525C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(11) | V98U9526C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(12) | V98U9527C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(2) | V98U9517C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(3) | V98U9518C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(4) | V98U9519C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |

TABLE 4.39-4. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| RELV(5) | V98U9520C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(6) | V98U9521C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(7) | V98U9522C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(8) | V98U9523C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| RELV(9) | V98U9524C | FT/SEC | F | S | M | P | G4.39 | 00 | DAQ | DC0599 | |
| TBIAS(1) | V98U9466C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TBIAS(2) | V98U9467C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TBIAS(3) | V98U9468C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TBIAS(4) | V98U9469C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TBIAS(5) | V98U9470C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TBIAS(6) | V98U9471C | DEG K | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(1) | V98U9460C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(2) | V98U9461C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(3) | V98U9462C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(4) | V98U9463C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(5) | V98U9464C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| TSLOPE(6) | V98U9465C | DEG K/FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| V_ADS | V98U9440C | FT/SEC | F | S | D | C | G4.39 | 00 | ZSK | DC0599 | |
| V_FREEZE | V98U9439C | FT/SEC | F | S | D | P | G4.39 | 00 | ZSK | DC0599 | |
| V_NAV/DEF | V98U9438C | FT/SEC | F | S | D | P | G4.39 | 00 | ZSK | DC0599 | |
| ZT(1) | V98U9472C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(2) | V98U9473C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(3) | V98U9474C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(4) | V98U9475C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(5) | V98U9476C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(6) | V98U9477C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |
| ZT(7) | V98U9478C | FT | F | S | M | X | G4.39 | 00 | PEN | DC0599 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

TABLE 4.39-5. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|-----------|----|-------------|----------------|----|--------|---|---------|---------|-------------|
| KAOA(1) | V98U9535C | 00 | -4.0 | E+00 DEG | F | S | C | G4.39 | 29621A | |
| KBARO(1) | V98U9545C | 00 | -1.000 | E+03 FT | F | S | C | G4.39 | 29621A | |
| KBARO(2) | V98U9546C | 00 | +8.000 | E+03 FT | F | S | C | G4.39 | 29621A | |
| KDR_ADTA | V98U9532C | 00 | +2.0 | E-03 ND | F | S | C | G4.39 | 29621A | |
| KEAS(1) | V98U9549C | 00 | +1.12 | E+02 FT/SEC | F | S | C | G4.39 | 29621A | |
| KEAS(2) | V98U9550C | 00 | +5.620 | E+02 FT/SEC | F | S | C | G4.39 | 29621A | |
| KHD1 | V97U3512C | 00 | +4.0 | E-05 FT/SEC | F | S | C | G4.39 | 29621A | |
| KHD2 | V98U9537C | 00 | +3.333 | E-01 ND | F | S | C | G4.39 | 29621A | |
| KHPC(2) | V98U9543C | 00 | +0.0 | E+00 FT | F | S | C | G4.39 | 29621A | |
| KMACH(1) | V97U3526C | 00 | +1.0 | E-01 ND | F | S | C | G4.39 | 29621A | |
| KPSC(2) | V98U9539C | 00 | +3.6 | E+01 IN-HG | F | S | C | G4.39 | 29621A | |
| KPTC(2) | V98U9541C | 00 | +5.2 | E+01 IN-HG | F | S | C | G4.39 | 29621A | |
| KQBAR(1) | V97U3587C | 00 | +1.48 | E+01 LBS/FT**2 | F | S | C | G4.39 | 29621A | |
| KQBAR(2) | V97U3588C | 00 | +3.750 | E+02 LBS/FT**2 | F | S | C | G4.39 | 29621A | |
| KR_ADTA(1) | V98U9533C | 00 | -2.25 | E+00 ND | F | S | C | G4.39 | 29621A | |
| KR_ADTA(2) | V98U9534C | 00 | +1.75 | E+00 ND | F | S | C | G4.39 | 29621A | |
| KVT(1) | V97U3718C | 00 | +1.12 | E+02 FT/SEC | F | S | C | G4.39 | 29621A | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.39-6. AIR DATA TRANSDUCER ASSEMBLY SOP (G4.39) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|-----------------------------|-----------|----|----------------|-----------|---------------------|--------|---|---------|---------|-------------|
| G_O GRAVITY BELOW 90 KM | V97U6151C | 00 | +9.80665 | E+00 | M/SEC**2 | F | S | P G4.39 | 90374C | |
| M_O MOLECULAR WEIGHT | V97U6212C | 00 | +2.89644 | E+01 | LBM/LBM-MOLE | F | S | P G4.39 | 90374C | |
| R UNIVERSAL GAS CONSTANT | V97U6213C | 00 | +8.31432 | E+00 | JOULES/(DEG K-MOLE) | F | S | P G4.39 | 90374C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.40 ORBITER RATE GYRO SOP

The purpose of the Orbiter Rate Gyro (ORB RG) SOP principal function shall be to perform data compensation of the measured Orbiter rate gyro roll, pitch, and yaw signals and to perform a monitoring function for the rate gyros. The compensation function shall be executed at the 25Hz rate during Major Modes 101, 102, 103 (until main engine zero thrust), 304, and 305 and 601 through 603; and at the 12.5 Hz rate after main engine zero thrust through Major Mode 106, and Major Modes 301 through 303. The ORB RG SOP shall be processed prior to the Selection Filter principal function.

The ORB RG compensation function shall consist of applying bias and scale factor terms to convert the measured rate data into engineering units (degrees/second) in floating point format. Provisions shall be made for unique scale factor and bias values for each measured signal. The compensation equation shall be as follows:

$$YC = YM C + K,$$

where

- YC = Compensated RG signal (deg/sec),
- YM = Measured RG signal (Vdc),
- C = Compensation scale factor (deg/sec/Vdc), and
- K = Compensation bias (deg/sec).

The Orbiter rate gyro monitoring function shall be performed by the ORB RG FDIR. Three signals (roll, pitch, and yaw) are generated by each of four independent rate gyros. Thus, four sets of signals are available to the ORB RG FDIR for monitoring. If an “out-of-range” signal is received, this signal is deleted and a mid-value select is performed on the remaining “in-range” signals.

The ORB RG SOP interfaces are indicated on the functional block diagram on Figure 4.40-1. The parameter initialization requirements are shown in Table 4.40-1. The IDD inputs and outputs are listed in Tables 4.40-2 and 4.40-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.40-4. K-loads are listed in Table 4.40-5. Constants are listed in Table 4.40-6. During OPS3 (MM301 Only) the compensation bias terms can be changed from their initialized values by uplink, however the uplinked biases will not be preserved across OPS transitions.

Table 4.40-1. Orbiter RG SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|----------|-----------|--------------------------------|------------|-------------|---------------|---------------|-----------------|
| CP(1) | V97U3418C | COMP SCALE FACTOR—ROLL RATE 1 | K | FLOAT PT | + 8.0 | +8.8, +7.2 | DEG/SEC/ VDC |
| CP(2) | V97U3419C | COMP SCALE FACTOR—ROLL RATE 2 | K | FLOAT PT | + 8.0 | +8.8, +7.2 | DEG/SEC/ VDC |
| CP(3) | V97U3420C | COMP SCALE FACTOR—ROLL RATE 3 | K | FLOAT PT | + 8.0 | +8.8, +7.2 | DEG/SEC/ VDC |
| CP(4) | V97U3421C | COMP SCALE FACTOR—ROLL RATE 4 | K | FLOAT PT | + 8.0 | +8.8, +7.2 | DEG/SEC/ VDC |
| CQ(1) | V97U3422C | COMP SCALE FACTOR—PITCH RATE 1 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CQ(2) | V97U3423C | COMP SCALE FACTOR—PITCH RATE 2 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CQ(3) | V97U3424C | COMP SCALE FACTOR—PITCH RATE 3 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CQ(4) | V97U3425C | COMP SCALE FACTOR—ROLL RATE 4 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CR(1) | V97U3426C | COMP SCALE FACTOR—YAW RATE 1 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CR(2) | V97U3427C | COMP SCALE FACTOR—YAW RATE 2 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CR(3) | V97U3428C | COMP SCALE FACTOR—YAW RATE 3 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| CR(4) | V97U3429C | COMP SCALE FACTOR—YAW RATE 4 | K | FLOAT PT | + 4.0 | +4.4, +3.6 | DEG/SEC/ VDC |
| KPORB(1) | V97U3532C | COMP BIAS—ROLL RATE 1 | K | FLOAT PT | + 0.0 | +0.3 -0.3 | DEG/SEC |
| KPORB(2) | V97U3533C | COMP BIAS—ROLL RATE 2 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KPORB(3) | V97U3534C | COMP BIAS—ROLL RATE 3 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KPORB(4) | V97U3535C | COMP BIAS—ROLL RATE 4 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KQ(1) | V97U3583C | COMP BIAS—PITCH RATE 1 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KQ(2) | V97U3584C | COMP BIAS—PITCH RATE 2 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KQ(3) | V97U3585C | COMP BIAS—PITCH RATE 3 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KQ(4) | V97U3586C | COMP BIAS—PITCH RATE 4 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KRORB(1) | V97U3589C | COMP BIAS—YAW RATE 1 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KRORB(2) | V97U3590C | COMP BIAS—YAW RATE 2 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KRORB(3) | V97U3591C | COMP BIAS—YAW RATE 3 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KRORB(4) | V97U3592C | COMP BIAS—YAW RATE 4 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |

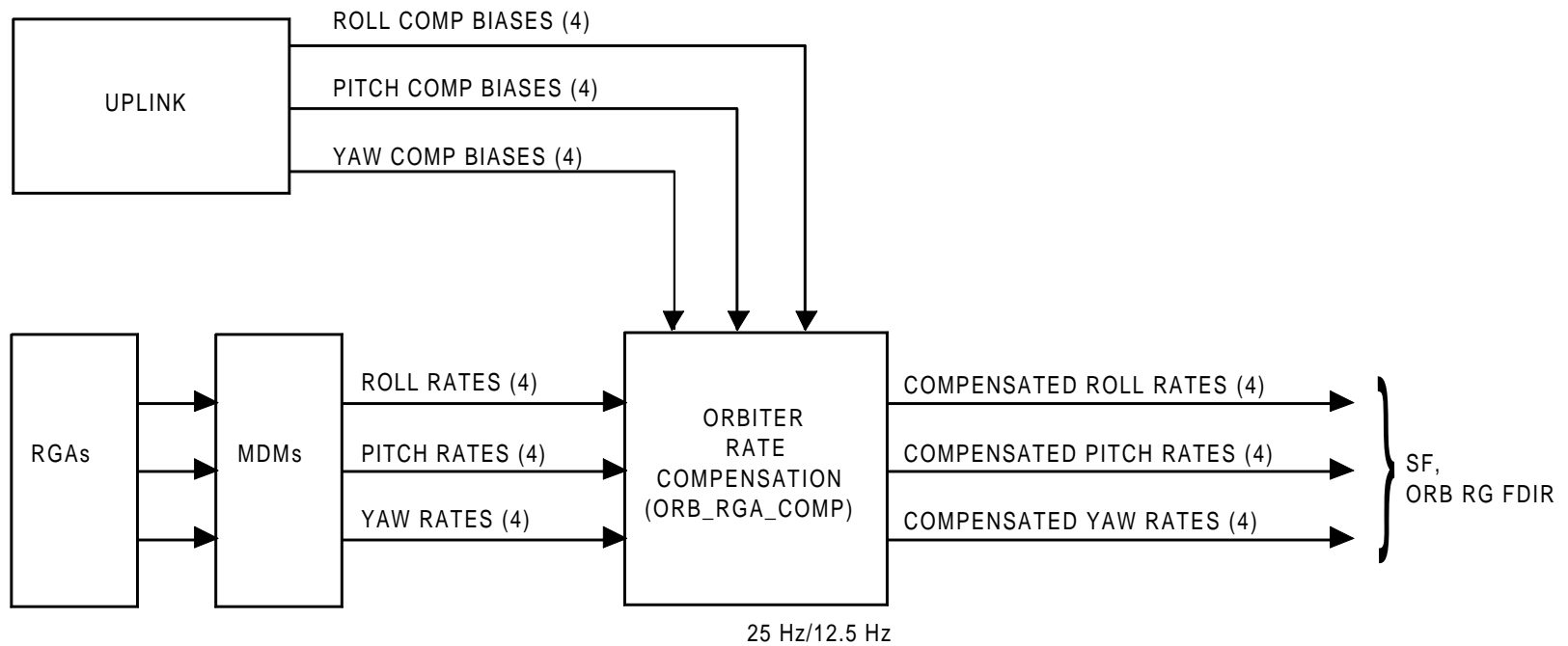


FIGURE 4.40-1. Orbiter RG SOP Functional Block Diagram

TABLE 4.40-2. INPUT FUNCTIONAL PARAMETERS FOR ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|------------------------|--------|-------|--------------|------------------|---------|-------------|
| KPORB(1) | V97U3532C | COMP BIAS-ROLL RATE 1 | UL | DEG/S | SPL | | 89823C | |
| KPORB(2) | V97U3533C | COMP BIAS-ROLL RATE 2 | UL | DEG/S | SPL | | 89823C | |
| KPORB(3) | V97U3534C | COMP BIAS-ROLL RATE 3 | UL | DEG/S | SPL | | 89823C | |
| KPORB(4) | V97U3535C | COMP BIAS-ROLL RATE 4 | UL | DEG/S | SPL | | 89823C | |
| KQ(1) | V97U3583C | COMP BIAS-PITCH RATE 1 | UL | DEG/S | SPL | | 89823C | |
| KQ(2) | V97U3584C | COMP BIAS-PITCH RATE 2 | UL | DEG/S | SPL | | 89823C | |
| KQ(3) | V97U3585C | COMP BIAS-PITCH RATE 3 | UL | DEG/S | SPL | | 89823C | |
| KQ(4) | V97U3586C | COMP BIAS-PITCH RATE 4 | UL | DEG/S | SPL | | 89823C | |
| KRORB(1) | V97U3589C | COMP BIAS-YAW RATE 1 | UL | DEG/S | SPL | | 89823C | |
| KRORB(2) | V97U3590C | COMP BIAS-YAW RATE 2 | UL | DEG/S | SPL | | 89823C | |
| KRORB(3) | V97U3591C | COMP BIAS-YAW RATE 3 | UL | DEG/S | SPL | | 89823C | |
| KRORB(4) | V97U3592C | COMP BIAS-YAW RATE 4 | UL | DEG/S | SPL | | 89823C | |
| PM(1) | V79R1830C | RGA 1 ROLL RATE | RGAO 1 | VDC | AMB | | 93017G | * |
| PM(2) | V79R1835C | RGA 2 ROLL RATE | RGAO 2 | VDC | AMB | | 93017G | * |
| PM(3) | V79R1840C | RGA 3 ROLL RATE | RGAO 3 | VDC | AMB | | 93017G | * |
| PM(4) | V79R1845C | RGA 4 ROLL RATE | RGAO 4 | VDC | AMB | | 93017G | * |
| QM(1) | V79R1831C | RGA 1 PITCH RATE | RGAO 1 | VDC | AMB | | 93017G | * |
| QM(2) | V79R1836C | RGA 2 PITCH RATE | RGAO 2 | VDC | AMB | | 93017G | * |
| QM(3) | V79R1841C | RGA 3 PITCH RATE | RGAO 3 | VDC | AMB | | 93017G | * |
| QM(4) | V79R1846C | RGA 4 PITCH RATE | RGAO 4 | VDC | AMB | | 93017G | * |
| RM(1) | V79R1832C | RGA 1 YAW RATE | RGAO 1 | VDC | AMB | | 93017G | * |
| RM(2) | V79R1837C | RGA 2 YAW RATE | RGAO 2 | VDC | AMB | | 93017G | * |
| RM(3) | V79R1842C | RGA 3 YAW RATE | RGAO 3 | VDC | AMB | | 93017G | * |
| RM(4) | V79R1847C | RGA 4 YAW RATE | RGAO 4 | VDC | AMB | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.40-3. OUTPUT FUNCTIONAL PARAMETERS FROM ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|--------------------------|---|-------|-----------|---------|---------|-------|
| PC(1) | V95R4001C | COMPENSATED ROLL RATE 1 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| PC(2) | V95R4002C | COMPENSATED ROLL RATE 2 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| PC(3) | V95R4003C | COMPENSATED ROLL RATE 3 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| PC(4) | V95R4004C | COMPENSATED ROLL RATE 4 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| QC(1) | V95R4031C | COMPENSATED PITCH RATE 1 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| QC(2) | V95R4032C | COMPENSATED PITCH RATE 2 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| QC(3) | V95R4033C | COMPENSATED PITCH RATE 3 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| QC(4) | V95R4034C | COMPENSATED PITCH RATE 4 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| RC(1) | V95R4061C | COMPENSATED YAW RATE 1 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| RC(2) | V95R4062C | COMPENSATED YAW RATE 2 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |
| RC(3) | V95R4063C | COMPENSATED YAW RATE 3 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |

TABLE 4.40-3. OUTPUT FUNCTIONAL PARAMETERS FROM ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM
(G4.40)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|------------------------|---|-------|-----------|------------------|---------|-------------|
| RC(4) | V95R4064C | COMPENSATED YAW RATE 4 | DL FMT 21/1 DL FMT 23/1 ORB RG FDIR SF | DEG/S | SPL | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.40-4. ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.40-5. ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|---|-----------|----|-------------|-----------|-------------|--------|---|---------|---------|-------------|
| CP(1) COMP SCALE FACTOR - ROLL RATE 1 | V97U3418C | 00 | +8.0000000 | E+00 | DEG/SEC/VDC | F | S | A G4.40 | 90094C | |
| CP(2) COMP SCALE FACTOR - ROLL RATE 2 | V97U3419C | 00 | +8.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CP(3) COMP SCALE FACTOR - ROLL RATE 3 | V97U3420C | 00 | +8.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CP(4) COMP SCALE FACTOR - ROLL RATE 4 | V97U3421C | 00 | +8.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CQ(1) COMP SCALE FACTOR - PITCH RATE 1 | V97U3422C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | A G4.40 | 90094C | |
| CQ(2) COMP SCALE FACTOR - PITCH RATE 2 | V97U3423C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CQ(3) COMP SCALE FACTOR - PITCH RATE 3 | V97U3424C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CQ(4) COMP SCALE FACTOR - PITCH RATE 4 | V97U3425C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CR(1) COMP SCALE FACTOR - YAW RATE 1 | V97U3426C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | A G4.40 | 90094C | |
| CR(2) COMP SCALE FACTOR - YAW RATE 2 | V97U3427C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CR(3) COMP SCALE FACTOR - YAW RATE 3 | V97U3428C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| CR(4) COMP SCALE FACTOR - YAW RATE 4 | V97U3429C | 00 | +4.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.40 | 90094C | |
| KPORB(1) COMP BIAS - ROLL RATE 1 | V97U3532C | 00 | +0.0 | E+00 | DEG/SEC | F | S | C G4.40 | 90094C | |
| KPORB(2) COMP BIAS - ROLL RATE 2 | V97U3533C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KPORB(3) COMP BIAS - ROLL RATE 3 | V97U3534C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KPORB(4) COMP BIAS - ROLL RATE 4 | V97U3535C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KQ(1) COMP BIAS - PITCH RATE 1 | V97U3583C | 00 | +0.0 | E+00 | DEG/SEC | F | S | C G4.40 | 90094C | |
| KQ(2) COMP BIAS - PITCH RATE 2 | V97U3584C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KQ(3) COMP BIAS - PITCH RATE 3 | V97U3585C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KQ(4) COMP BIAS - PITCH RATE 4 | V97U3586C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KRORB(1) COMP BIAS - YAW RATE 1 | V97U3589C | 00 | +0.0 | E+00 | DEG/SEC | F | S | C G4.40 | 90094C | |
| KRORB(2) COMP BIAS - YAW RATE 2 | V97U3590C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |
| KRORB(3) COMP BIAS - YAW RATE 3 | V97U3591C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.40 | 90094C | |

TABLE 4.40-5. ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|------------------------------------|-----------|----|-------------|--------------|----|--------|---|---------|---------|-------------|
| KRORB(4) COMP BIAS - YAW RATE 4 | V97U3592C | 00 | +0.0 | E+00 DEG/SEC | F | | S | P G4.40 | 90094C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

TABLE 4.40-6. ORBITER RATE GYRO SUBSYSTEM OPERATING PROGRAM (G4.40) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

4.41 SRB RATE GYRO SOP

The purpose of the SRB Rate Gyro (SRB RG) SOP principal function shall be to perform data compensation of the measured SRB rate gyro pitch and yaw signals. The compensation function shall be executed at the 25 Hz rate prior to the Selection Filter principal function.

The SRB RG compensation function shall consist of applying bias and scale factor terms to convert the measured rate data into engineering units (degrees/second) in floating point format. Provisions shall be made for unique scale factor and bias values for each measured signal. The compensation equation shall be as follows:

$$YC = YM C + K,$$

where

YC = Compensated signal (deg/sec),

YM = Measured signal (Vdc),

C = Compensation scale factor (deg/sec/Vdc), and

K = Compensation bias (deg/sec).

The SRB RG SOP interfaces are indicated on the functional block diagram, Figure 4.41-1. The parameter initialization requirements are shown in Table 4.41-1. The IDD inputs and outputs are listed in Tables 4.41-2 and 4.41-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.41-4. K-loads are listed in Table 4.41-5. Constants are listed in Table 4.41-6.

| Table 4.41-1. SRB RG SOP Initialization Parameters | | | | | | | |
|--|-----------|------------------------------------|------------|-------------|---------------|------------|-------------|
| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
| CSRQB(1) | V97U3408C | COMP SCALE FACTOR—SRB PITCH RATE 1 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRQB(2) | V97U3469C | COMP SCALE FACTOR—SRB PITCH RATE 2 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRQB(3) | V97U3410C | COMP SCALE FACTOR—SRB PITCH RATE 3 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRQB(4) | V97U3411C | COMP SCALE FACTOR—SRB PITCH RATE 4 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRBR(1) | V97U3441C | COMP SCALE FACTOR—SRB YAW RATE 1 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRBR(2) | V97U3442C | COMP SCALE FACTOR—SRB YAW RATE 2 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRBR(3) | V97U3443C | COMP SCALE FACTOR—SRB YAW RATE 3 | K | FLOAT PT | + 2.0 | +2.2, +1.8 | DEG/SEC/VDC |
| CSRBR(4) | V97U3444C | COMP SCALE FACTOR—SRB YAW RATE 4 | K | FLOAT PT | + 0.0 | +2.2, +1.8 | DEG/SEC/VDC |
| KSRBQ(1) | V97U3520C | COMP BIAS—SRB PITCH RATE 1 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBQ(2) | V97U3521C | COMP BIAS—SRB PITCH RATE 2 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBQ(3) | V97U3522C | COMP BIAS—SRB PITCH RATE 3 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBQ(4) | V97U3523C | COMP BIAS—SRB PITCH RATE 4 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBR(1) | V97U3608C | COMP BIAS—SRB YAW RATE 1 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBR(2) | V97U3609C | COMP BIAS—SRB YAW RATE 2 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBR(3) | V97U3610C | COMP BIAS—SRB YAW RATE 3 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |
| KSRBR(4) | V97U3611C | COMP BIAS—SRB YAW RATE 4 | K | FLOAT PT | + 0.0 | +0.3, -0.3 | DEG/SEC |

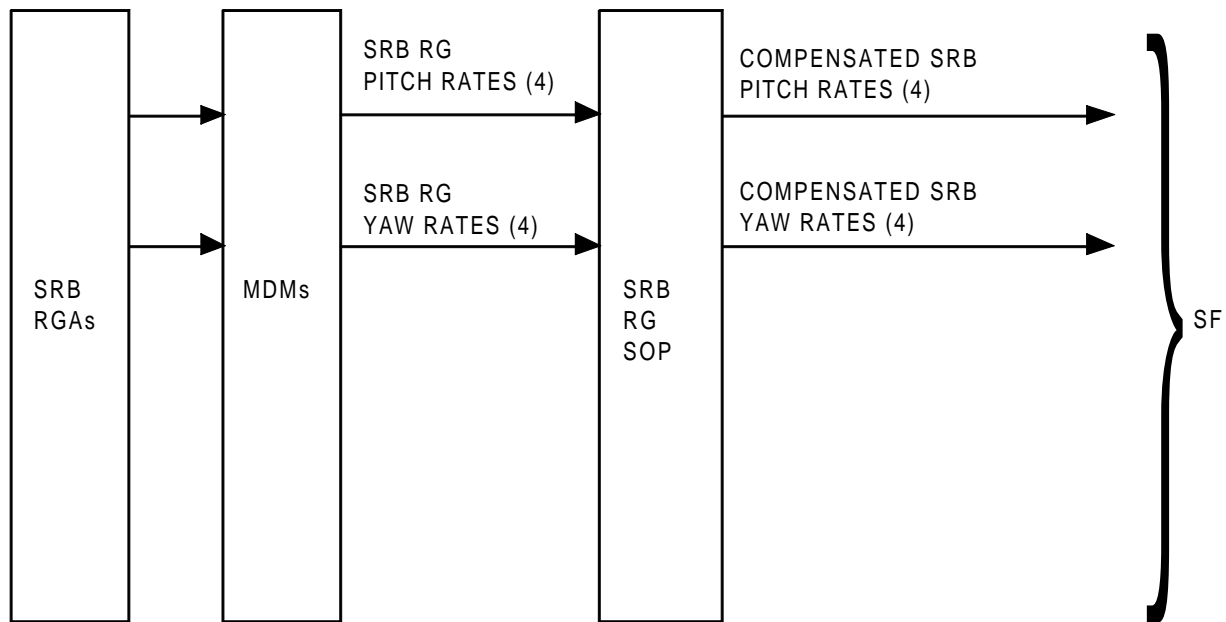


FIGURE 4.41-1. SRB Rate Gyro SOP Functional Block Diagram

TABLE 4.41-2. INPUT FUNCTIONAL PARAMETERS FOR SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|-------------------|--------|-------|--------------|------------------|---------|-------------|
| RGQM(1) | B79R1410C | SRGA 1 PITCH RATE | SRGA 1 | VDC | | | 93017G | * |
| RGQM(2) | B79R2410C | SRGA 2 PITCH RATE | SRGA 2 | VDC | | | 93017G | * |
| RGQM(3) | B79R1412C | SRGA 3 PITCH RATE | SRGA 3 | VDC | | | 93017G | * |
| RGQM(4) | B79R2412C | SRGA 4 PITCH RATE | SRGA 4 | VDC | | | 93017G | * |
| RGRM(1) | B79R1411C | SRGA 1 YAW RATE | SRGA 1 | VDC | | | 93017G | * |
| RGRM(2) | B79R2411C | SRGA 2 YAW RATE | SRGA 2 | VDC | | | 93017G | * |
| RGRM(3) | B79R1413C | SRGA 3 YAW RATE | SRGA 3 | VDC | | | 93017G | * |
| RGRM(4) | B79R2413C | SRGA 4 YAW RATE | SRGA 4 | VDC | | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.41-3. OUTPUT FUNCTIONAL PARAMETERS FROM SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|-------------------------------|----------------------------------|-------|-----------|------------------|---------|-------------|
| SRBQC(1) | V95R4260C | STRING 1 SRGA COMP PITCH RATE | DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBQC(2) | V95R4262C | STRING 2 SRGA COMP PITCH RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBQC(3) | V95R4270C | STRING 3 SRGA COMP PITCH RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBQC(4) | V95R4272C | STRING 4 SRGA COMP PITCH RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBRC(1) | V95R4261C | STRING 1 SRGA COMP YAW RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBRC(2) | V95R4263C | STRING 2 SRGA COMP YAW RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBRC(3) | V95R4271C | STRING 3 SRGA COMP YAW RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |
| SRBRC(4) | V95R4273C | STRING 4 SRGA COMP YAW RATE | SRB RG FDIR DL FMT 21/1 SF | DEG/S | | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
 (HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec

TABLE 4.41-4. SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.41-5. SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--|-----------|----|-------------|-----------|-------------|--------|---|---------|---------|-------------|
| CSRBQ(1) COMP SCALE FACTOR - SRB P RATE 1 | V97U3408C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | A G4.41 | 90094C | |
| CSRBQ(2) COMP SCALE FACTOR - SRB P RATE 2 | V97U3469C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 92102B | |
| CSRBQ(3) COMP SCALE FACTOR - SRB P RATE 3 | V97U3410C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 90094C | |
| CSRBQ(4) COMP SCALE FACTOR - SRB P RATE 4 | V97U3411C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 90094C | |
| CSRBR(1) COMP SCALE FACTOR - SRB Y RATE 1 | V97U3441C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | A G4.41 | 90094C | |
| CSRBR(2) COMP SCALE FACTOR - SRB Y RATE 2 | V97U3442C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 90094C | |
| CSRBR(3) COMP SCALE FACTOR - SRB Y RATE 3 | V97U3443C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 90094C | |
| CSRBR(4) COMP SCALE FACTOR - SRB Y RATE 3 | V97U3444C | 00 | +2.0000000 | E+00 | DEG/SEC/VDC | F | S | P G4.41 | 90094C | |
| KSRBQ(1) COMP BIAS - SRB PITCH RATE 1 | V97U3520C | 00 | +0.0 | E+00 | DEG/SEC | F | S | C G4.41 | 90094C | |
| KSRBQ(2) COMP BIAS - SRB PITCH RATE 2 | V97U3521C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |
| KSRBQ(3) COMP BIAS - SRB PITCH RATE 3 | V97U3522C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |
| KSRBQ(4) COMP BIAS - SRB PITCH RATE 4 | V97U3523C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |
| KSRBR(1) COMP BIAS - SRB YAW RATE 1 | V97U3608C | 00 | +0.0 | E+00 | DEG/SEC | F | S | C G4.41 | 90094C | |
| KSRBR(2) COMP BIAS - SRB YAW RATE 2 | V97U3609C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |
| KSRBR(3) COMP BIAS - SRB YAW RATE 3 | V97U3610C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |
| KSRBR(4) COMP BIAS - SRB YAW RATE 4 | V97U3611C | 00 | +0.0 | E+00 | DEG/SEC | F | S | P G4.41 | 90094C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.41-6. SOLID ROCKET BOOSTER RATE GYRO SOP (G4.41) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.42 ACCELEROMETER ASSEMBLY SOP

The purpose of the Accelerometer Assembly (AA) SOP principal function shall be to perform data compensation of the measured AA lateral and normal acceleration signals. The compensation function shall be executed at the 25 Hz rate prior to the Selection Filter principal function except for Major Modes 301, 302, 303 where it shall be executed at the 0.52 Hz rate.

The AA SOP compensation function shall consist of applying biases and scale factors to convert the measured accelerometer data into engineering units (gs) in floating point format. Unique bias and scale factor values for each measured signal shall be provided. The general compensation equation shall be as follows:

$$\begin{aligned} \text{NC} &= (\text{NM}) (\text{CN}) + \text{KN} \\ \text{LC} &= (\text{LM}) (\text{CL}) + \text{KL} + (\text{NC}) (\text{S}) \end{aligned}$$

where

NC/LC = Compensated Normal/Lateral AA signal (gs),
NM/LM = Measured Normal/Lateral AA signal (Vdc),
CN/CL = Compensation scale factor (gs/Vdc),
KN = Compensation Bias Normal,
KL = Compensation Bias Lateral,
S = Lateral AA misalignment angle (radians).

The AA SOP interfaces are indicated on the functional block diagram on Figure 4.42-1. The parameter initialization requirements are shown in Table 4.42-1. The IDD inputs and outputs are listed in Tables 4.42-2 and 4.42-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.42-4. K-loads are listed in Table 4.42-5. Constants are listed in Table 4.42-6. During OPS3 (MM301 Only) the compensation bias terms can be changed from their initialized values by uplink, however the uplinked biases will not be preserved across OPS transitions.

Table 4.42-1. AA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|-------|-----------|---------------------------------|------------|-------------|---------------|-----------------|---------|
| CL(1) | V97U3404C | COMP SCALE FACTOR—LAT ACCLRM 1 | K | FLOAT PT | + 0.2 | +0.22, +0.18 | gs/VDC |
| CL(2) | V97U3405C | COMP SCALE FACTOR—LAT ACCLRM 2 | K | FLOAT PT | + 0.2 | +0.22, +0.18 | gs/VDC |
| CL(3) | V97U3406C | COMP SCALE FACTOR—LAT ACCLRM 3 | K | FLOAT PT | + 0.2 | +0.22, +0.18 | gs/VDC |
| CL(4) | V97U3407C | COMP SCALE FACTOR—LAT ACCLRM 4 | K | FLOAT PT | + 0.2 | +0.22, +0.18 | gs/VDC |
| CN(1) | V97U3414C | COMP SCALE FACTOR—NORM ACCLRM 1 | K | FLOAT PT | + 0.8 | +0.88 +0.72 | gs/VDC |
| CN(2) | V97U3415C | COMP SCALE FACTOR—NORM ACCLRM 2 | K | FLOAT PT | + 0.8 | +0.88, +0.72 | gs/VDC |
| CN(3) | V97U3416C | COMP SCALE FACTOR—NORM ACCLRM 3 | K | FLOAT PT | + 0.8 | +0.88, +0.72 | gs/VDC |
| CN(4) | V97U3417C | COMP SCALE FACTOR—NORM ACCLRM 4 | K | FLOAT PT | + 0.8 | +0.88, +0.72 | gs/VDC |
| KL(1) | V97U3515C | COMP BIAS—LAT ACCLRM 1 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KL(2) | V97U3516C | COMP BIAS—LAT ACCLRM 2 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KL(3) | V97U3517C | COMP BIAS—LAT ACCLRM 3 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KL(4) | V97U3518C | COMP BIAS—LAT ACCLRM 4 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KN(1) | V97U3528C | COMP BIAS—NORM ACCLRM 1 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KN(2) | V97U3529C | COMP BIAS—NORM ACCLRM 2 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KN(3) | V97U3530C | COMP BIAS—NORM ACCLRM 3 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| KN(4) | V97U3531C | COMP BIAS—NORM ACCLRM 4 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | gs |
| S(1) | V97U8739C | MISALIGNMENT—LAT ACCLRM 1 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | RADIANS |
| S(2) | V97U8740C | MISALIGNMENT—LAT ACCLRM 2 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | RADIANS |
| S(3) | V97U8741C | MISALIGNMENT—LAT ACCLRM 3 | K | FLOAT PT | + 0.0 | +0.1, -0.1 | RADIANS |
| S(4) | V97U8742C | MISALIGNMENT—LAT ACCLRM 4 | K | FLOAT PT | + 0.0 | +0.1 -0.1 | RADIANS |

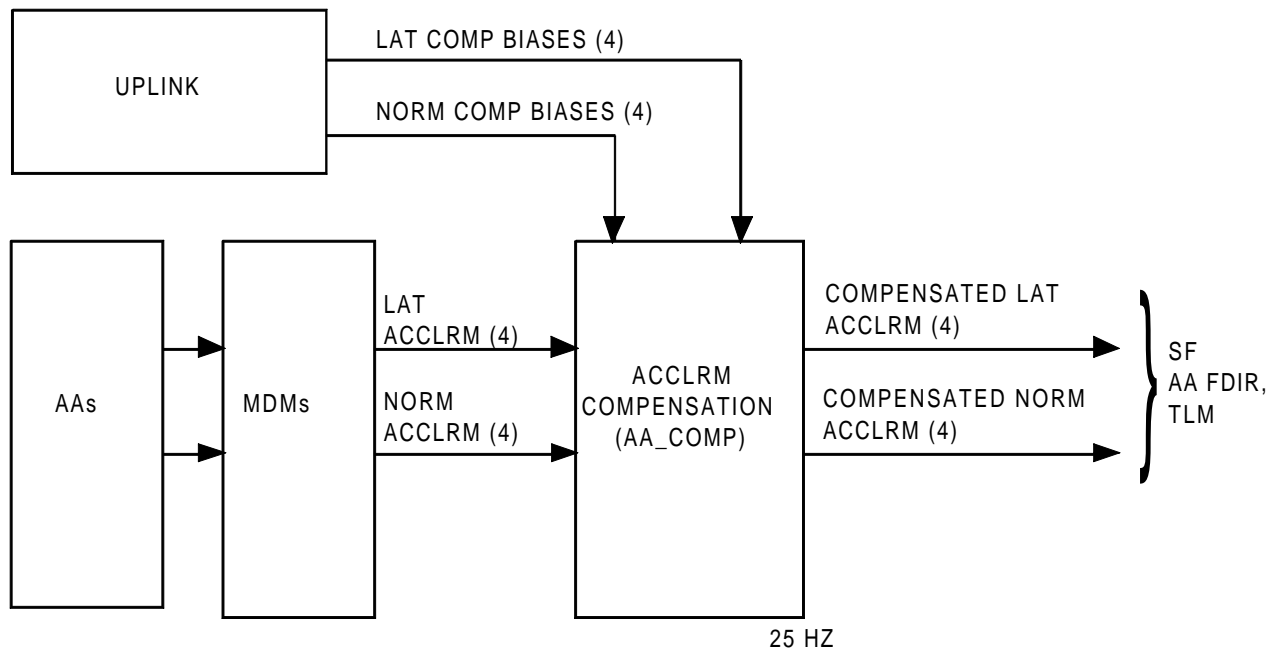


FIGURE 4.42-1. AA SOP Functional Block Diagram

TABLE 4.42-2. INPUT FUNCTIONAL PARAMETERS FOR ACCELEROMETER ASSEMBLY SOP (G4.42)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|-------------------------|--------|-------|-----------|---------|---------|-------|
| KL(1) | V97U3515C | COMP BIAS-LAT ACCLRM 1 | UL | G | SPL | | 89823C | |
| KL(2) | V97U3516C | COMP BIAS-LAT ACCLRM 2 | UL | G | SPL | | 89823C | |
| KL(3) | V97U3517C | COMP BIAS-LAT ACCLRM 3 | UL | G | SPL | | 89823C | |
| KL(4) | V97U3518C | COMP BIAS-LAT ACCLRM 4 | UL | G | SPL | | 89823C | |
| KN(1) | V97U3528C | COMP BIAS-NORM ACCLRM 1 | UL | G | SPL | | 89823C | |
| KN(2) | V97U3529C | COMP BIAS-NORM ACCLRM 2 | UL | G | SPL | | 89823C | |
| KN(3) | V97U3530C | COMP BIAS-NORM ACCLRM 3 | UL | G | SPL | | 89823C | |
| KN(4) | V97U3531C | COMP BIAS-NORM ACCLRM 4 | UL | G | SPL | | 89823C | |
| LM(1) | V79A2040C | ACCEL ASSY 1 LAT ACCEL | AA 1 | VDC | AMB | | 93017G | * |
| LM(2) | V79A2043C | ACCEL ASSY 2 LAT ACCEL | AA 2 | VDC | AMB | | 93017G | * |
| LM(3) | V79A2046C | ACCEL ASSY 3 LAT ACCEL | AA 3 | VDC | AMB | | 93017G | * |
| LM(4) | V79A2048C | ACCEL ASSY 4 LAT ACCEL | AA 4 | VDC | AMB | | 93017G | * |
| NM(1) | V79A2041C | ACCEL ASSY 1 NORM ACCEL | AA 1 | VDC | AMB | | 93017G | * |
| NM(2) | V79A2044C | ACCEL ASSY 2 NORM ACCEL | AA 2 | VDC | AMB | | 93017G | * |
| NM(3) | V79A2047C | ACCEL ASSY 3 NORM ACCEL | AA 3 | VDC | AMB | | 93017G | * |
| NM(4) | V79A2049C | ACCEL ASSY 4 NORM ACCEL | AA 4 | VDC | AMB | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.42-3. OUTPUT FUNCTIONAL PARAMETERS FROM ACCELEROMETER ASSEMBLY SOP (G4.42)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|---------------------------|---|-------|-----------|---------|---------|-------|
| LC(1) | V95A4101C | COMPENSATED LAT ACCELN 1 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| LC(2) | V95A4102C | COMPENSATED LAT ACCELN 2 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| LC(3) | V95A4103C | COMPENSATED LAT ACCELN 3 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| LC(4) | V95A4104C | COMPENSATED LAT ACCELN 4 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| NC(1) | V95A4151C | COMPENSATED NORM ACCELN 1 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| NC(2) | V95A4152C | COMPENSATED NORM ACCELN 2 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| NC(3) | V95A4153C | COMPENSATED NORM ACCELN 3 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |
| NC(4) | V95A4154C | COMPENSATED NORM ACCELN 4 | AA FDIR DL FMT 21/1 DL FMT 23/1 SF | G | SPL | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
 (HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec

TABLE 4.42-4. ACCELEROMETER ASSEMBLY SOP (G4.42) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.42-5. ACCELEROMETER ASSEMBLY SOP (G4.42) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--|-----------|----|-------------|-----------|-------|--------|---|---------|---------|-------------|
| CL(1) COMP SCALE FACTOR - LAT ACCLRM 1 | V97U3404C | 00 | +2.0 | E-01 | G/VDC | F | S | A G4.42 | 90094C | |
| CL(2) COMP SCALE FACTOR - LAT ACCLRM 2 | V97U3405C | 00 | +2.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| CL(3) COMP SCALE FACTOR - LAT ACCLRM 3 | V97U3406C | 00 | +2.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| CL(4) COMP SCALE FACTOR - LAT ACCLRM 4 | V97U3407C | 00 | +2.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| CN(1) COMP SCALE FACTOR - NORM ACCLRM 1 | V97U3414C | 00 | +8.0 | E-01 | G/VDC | F | S | A G4.42 | 90094C | |
| CN(2) COMP SCALE FACTOR - NORM ACCLRM 2 | V97U3415C | 00 | +8.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| CN(3) COMP SCALE FACTOR - NORM ACCLRM 3 | V97U3416C | 00 | +8.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| CN(4) COMP SCALE FACTOR - NORM ACCLRM 4 | V97U3417C | 00 | +8.0 | E-01 | G/VDC | F | S | P G4.42 | 90094C | |
| KL(1) COMP BIAS - LAT ACCLRM 1 | V97U3515C | 00 | +0.0 | E+00 | G | F | S | C G4.42 | 90094C | |
| KL(2) COMP BIAS - LAT ACCLRM 2 | V97U3516C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| KL(3) COMP BIAS - LAT ACCLRM 3 | V97U3517C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| KL(4) COMP BIAS - LAT ACCLRM 4 | V97U3518C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| KN(1) COMP BIAS - NORM ACCLRM 1 | V97U3528C | 00 | +0.0 | E+00 | G | F | S | C G4.42 | 90094C | |
| KN(2) COMP BIAS - NORM ACCLRM 2 | V97U3529C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| KN(3) COMP BIAS - NORM ACCLRM 3 | V97U3530C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| KN(4) COMP BIAS - NORM ACCLRM 4 | V97U3531C | 00 | +0.0 | E+00 | G | F | S | P G4.42 | 90094C | |
| S(1) MISALIGN/LAT AA1 | V97U8739C | 00 | +0.0 | E+00 | RAD | F | S | C G4.42 | 90094C | |
| S(2) MISALIGN/LAT AA2 | V97U8740C | 00 | +0.0 | E+00 | RAD | F | S | C G4.42 | 90094C | |
| S(3) MISALIGN/LAT AA3 | V97U8741C | 00 | +0.0 | E+00 | RAD | F | S | C G4.42 | 90094C | |
| S(4) MISALIGN/LAT AA4 | V97U8742C | 00 | +0.0 | E+00 | RAD | F | S | C G4.42 | 90254 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.42-6. ACCELEROMETER ASSEMBLY SOP (G4.42) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.51 BODY FLAP SLEW COMMAND SOP

The purpose of the Body Flap Slew Command (BF SLEW) SOP principal function shall be to perform the station select process for the manual body flap switches. This function shall be executed at the 6.25 Hz rate after GN&C SW RM and prior to AERO-JET DAP and GRTLS DAP.

The station select processing for the manual body flap switches must be sequenced as follows:

- A. "OR" the selected positive signals from both crew stations to produce a resultant positive signal, "OR" the selected negative signals from both crew stations to produce a resultant negative signal.
- B. Convert resultant positive and negative signals from discrete to integer format as shown below.

| Resultant Positive Signal | Resultant Negative Signal | Manual Body Flap Command (Integer) |
|---------------------------|---------------------------|------------------------------------|
| False | False | 0 |
| False | True | -1 (up) |
| True | False | +1 (down) |
| True | True | -1 (up) |

When both crew stations generate conflicting body flap commands, the output shall be -1, as up has priority.

The BF SLEW SOP interfaces are indicated on the functional block diagram on Figure 4.51-1. The parameter initialization requirements are shown in Table 4.51-1. The IDD inputs and outputs are listed in Tables 4.51-2 and 4.51-3. Values for the I-loads are contained in the I-load requirements document (JSC- 19350); however, I-load definitions applicable to this principal function are listed in Table 4.51-4. K-loads are listed in Table 4.51-5. Constants are listed in Table 4.51-6.

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------|-----------|----------------------|------------|-------------|---------------|-------|-------|
| DBFMAN | V96J1021C | MANUAL BODY FLAP CMD | | INTEGER | 0 | | |

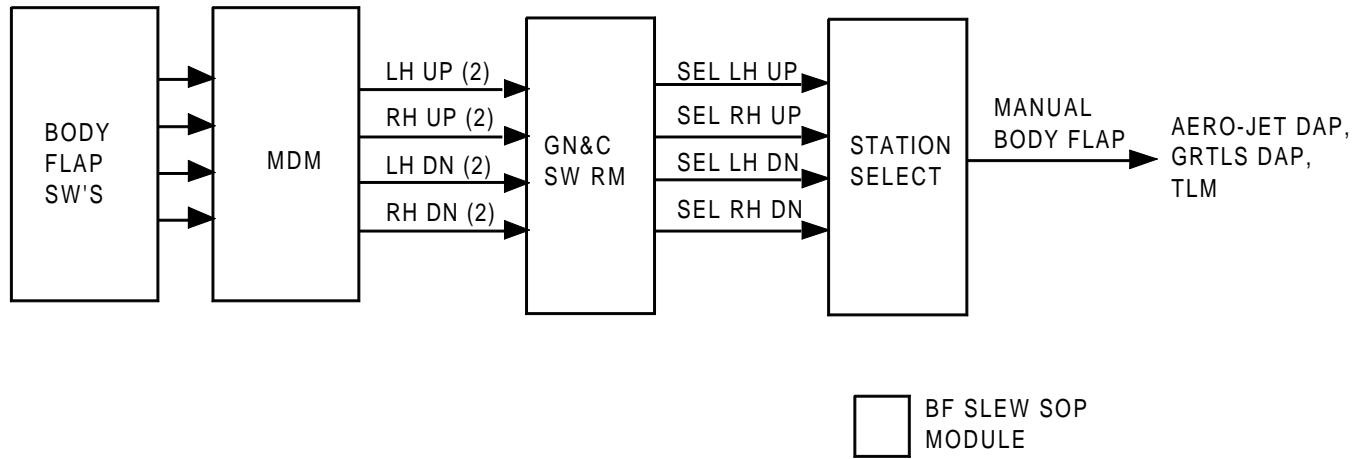


FIGURE 4.51-1. BF SLEW SOP Functional Block Diagram

TABLE 4.51-2. INPUT FUNCTIONAL PARAMETERS FOR BODY FLAP SLEW COMMAND SOP (G4.51)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|---------------------------------|------------|-------|-----------|------------------|---------|-------------|
| BFDNS(1) | V90X6520X | SEL LH MANUAL BODY FLAP (DN) SW | GN&C SW RM | | | | | |
| BFDNS(2) | V90X6620X | SEL RH MANUAL BODY FLAP (DN) SW | GN&C SW RM | | | | | |
| BFUPS(1) | V90X6510X | SEL LH MANUAL BODY FLAP (UP) SW | GN&C SW RM | | | | | |
| BFUPS(2) | V90X6610X | SEL RH MANUAL BODY FLAP (UP) SW | GN&C SW RM | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.51-3. OUTPUT FUNCTIONAL PARAMETERS FROM BODY FLAP SLEW COMMAND SOP (G4.51)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|----------------------|--|-------|--------------|------------------|---------|-------------|
| DBFMAN | V96J1021C | MANUAL BODY FLAP CMD | AEROJET DAP BF CMD RM GRTLS DAP TLM | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.51-4. BODY FLAP SLEW COMMAND SOP (G4.51) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.51-5. BODY FLAP SLEW COMMAND SOP (G4.51) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.51-6. BODY FLAP SLEW COMMAND SOP (G4.51) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

4.53 TWO-AXIS ROTATIONAL HAND CONTROLLER SOP

The purpose of the Two–Axis Rotational Hand Controller (2–AX RHC) SOP principal function shall be to perform the following functions:

- A. Compensation of the selected roll and pitch transducer commands by application of scale factors and biases,
- B. Processing of breakout deadbanding for the roll and pitch commands,
- C. Processing of the AUTO to CSS downmode discrete based on RHC deflections, and load relief,
- D. Processing of deadband signals for both crew stations to produce a resultant output command (station select), and
- E. Station select processing for the roll and pitch panel and RHC trim switches.

The 2–AX RHC SOP shall be executed in the order stated above after Selection Filter (SF) and prior to AERO–JET DAP. The RHC outputs must be processed at a rate of at least 12.5 Hz in MM 304 and 305, except for the final phases of approach and landing when the required rate is 25 Hz.

The downmode threshold and trim command processing is performed every fourth pass of the 2–AX RHC SOP (i.e., 6.25 Hz rate).

The 2–AX RHC SOP interfaces are indicated on the functional block diagram on Figure 4.53–1. The parameter initialization requirements are shown in Table 4.53–1. The IDD inputs and outputs are listed in Tables 4.53–2 and 4.53–3. Values for the I–loads are contained in the I–load requirements document (JSC– 19350); however, I–load definitions applicable to this principal function are listed in Table 4.53–4. K–loads are listed in Table 4.53–5. Constants are listed in Table 4.53–6.

Table 4.53-1. Two-Axis RHC SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|-------------------------|------------|--|------------|-------------|---------------|---------------------|---------|
| CRHCPC | V97U3431C | COMP SCALE FACTOR—LH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCPP | V97U3432C | COMP SCALE FACTOR—RH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRC | V97U3434C | COMP SCALE FACTOR—LH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRP | V97U3435C | COMP SCALE FACTOR—RH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| KRHCP | V97U3595C | COMP BIAS—LH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCPP | V97U3596C | COMP BIAS—RH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRC | V97U3598C | COMP BIAS—LH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRP | V97U3599C | COMP BIAS—RH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| DB1 | V97U3450C | DEADBAND 1 | D | FLOAT PT | | +1.265, +1.035 | DEG |
| DB2 | V97U3451C | DEADBAND 2 | D | FLOAT PT | | +1.265, +1.035 | DEG |
| RHC_PTCH_DNMD_THLD | V97U3739C | RHC PITCH DOWNMODE THRESHOLD | D | FLOAT PT | | +6.6, +5.4 | DEG |
| RHC_PTCH_DNMD_THLD_LREL | V97U3738C | RHC PITCH DOWNMODE THRESHOLD FOR LOAD RELIEF | D | FLOAT PT | | +12.6, +11.4 | DEG |
| RHC_RY_DNMD_THLD | V97U3740C | RHC ROLL/YAW DOWNMODE THRESHOLD | D | FLOAT PT | | +6.6, +5.4 | DEG |
| RHC_STATE(1) | V96J0015CB | RHC OUT OF DETENT ROLL | | DISCRETE | 0 | | |
| RHC_STATE(2) | V96J0017CB | RHC OUT OF DETENT PITCH | | DISCRETE | 0 | | DEG |
| DAMAN | V96H0005CA | MANUAL ROLL CMD | | FLOAT PT | 0 | | DEG |
| DEMAN | V96H0007CA | MANUAL PITCH CMD | | FLOAT PT | 0 | | DEG |
| DETM_RC | V96J1053C | MANUAL RHC PITCH TRIM | | INTEGER | 0 | | DEG |
| DATM_RC | V96J1054C | MANUAL RHC ROLL TRIM | | INTEGER | 0 | | DEG |
| DETM_PAN | V96J1013C | MANUAL PANEL PITCH TRIM | | INTEGER | 0 | | DEG |
| DATM_PAN | V96J1011C | MANUAL PANEL ROLL TRIM | | INTEGER | 0 | | DEG |

4.53.1 RHC Compensation

The RHC compensation function shall consist of applying scale factors and biases to convert the selected RHC roll and pitch commands into engineering units (degrees) in floating print format. Provisions shall be

made for unique scale factor and bias terms for each selected signal. The general compensation equation shall be as follows:

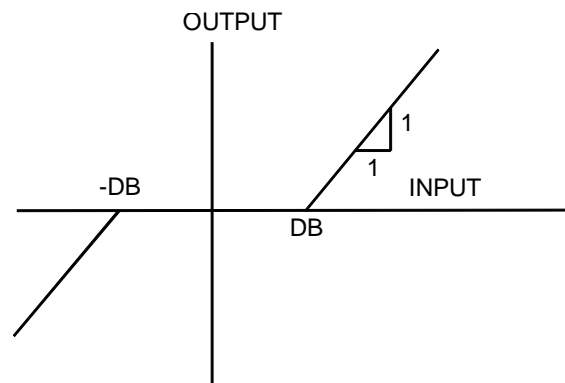
$$YC = YM C + K$$

where

- YC = Compensated signal (deg),
- YM = Measured signal (Vdc),
- C = Compensation scale factor (deg/Vdc), and
- K = Compensation bias (deg),

4.53.2 RHC Deadbanding

The RHC deadbanding function shall monitor SF data good flags and apply breakout deadbands to the compensated RHC roll and pitch commands for each crew station. The roll and pitch compensated signals from each RHC shall be deadbanded provided both roll and pitch data good flags are TRUE. If either data good signal for an RHC is FALSE, then the compensated roll and pitch signals from that RHC shall be set to zero. The deadband shall be DB2 degrees in pitch and DB1 degrees in roll and is implemented as shown in the following diagram.



The OUTPUT is computed as follows:

For $|\text{INPUT}| < \text{DB}$, $\text{OUTPUT} = 0$;

For $|\text{INPUT}| \geq \text{DB}$, $\text{OUTPUT} = \text{INPUT} - \text{DB SIGN}(\text{INPUT})$,

Where DB = DB2 degrees for pitch,
DB1 degrees for roll.

4.53.3 RHC Discrettes

The RHC discrete generating function shall monitor RHC deflections for each crew station and provide discrettes based on these deflections. There is no requirement to process the roll data before or after the pitch data.

When a compensated RHC deflection in an axis exceeds a specified threshold, a discrete shall be set to TRUE; otherwise, the discrete shall be set to FALSE. These discrettes are for use by the AERO-JET DAP in downmoding from AUTO to CSS. If the RHC is moved beyond the downmode threshold while MACH ≥ 1 with the DAP in AUTO, a signal shall be sent to the GAX to annunciate a Class 3 warning to the crew.

For the pitch channel, if LOAD_RELIEF equals OFF, then the threshold shall be RHC_PTCH_DNMD_THLD; else the threshold shall be RHC_PTCH_DNMD_LREL.

4.53.4 RHC Station Select

The RHC station select function shall provide a station select process for the RHC roll and pitch axis at each crew station.

The sum of the deadbanded roll signals and the sum of the deadbanded pitch signals shall be formed and sent from the SOP for use by AERO-JET DAP.

4.53.5 Roll and Pitch Trim Station Select

The trim station select function shall provide station select processes for the panel and RHC roll and pitch trim switches at each crew station.

A. Panel Trims

The station select process for the roll and pitch panel trims must be sequenced as follows:

1. “AND” the left selected trim signals with the “NOT” of the selected left RHC trim inhibit signal to produce enabled left trim signals. “AND” the right selected trim signals with the “NOT” of the selected right RHC trim inhibit signal to produce enabled right trim signals.
2. “OR” the enabled positive signals from both crew stations to produce a resultant positive signal. “OR” the enabled negative signals from both crew stations to produce a resultant negative signal.
3. Convert resultant positive and negative signals from discrete to integer format as shown below:

| Resultant Positive Signal | Resultant Negative Signal | Roll and Pitch RHC Command (Integer) |
|---------------------------|---------------------------|--------------------------------------|
| False | False | 0 |
| False | True | -1 |
| True | False | +1 |
| True | True | 0 |

When both crew stations generate conflicting trim commands, the output trim command shall be zero.

B. RHC Trims

The station select process for the roll and pitch RHC trims must be sequenced as follows:

1. If WOWLON_IND = 0
 - a. “AND” the left selected trim signals with the “NOT” of the selected left RHC trim inhibit signal to produce enabled left trim signals. “AND” the right selected trim signals with the “NOT” of the selected right RHC trim inhibit signal to produce enabled right trim signals.
 - b. “OR” the enabled positive signals from both crew stations to produce a resultant positive signal. “OR” the enabled negative signals from both crew stations to produce a resultant negative signal.
 - c. Convert resultant positive and negative signals from discrete to integer format as shown below:

| Resultant Positive Signal | Resultant Negative Signal | Roll and Pitch RHC Command (Integer) |
|---------------------------------|---------------------------------|--|
| False | False | 0 |
| False | True | -1 |
| True | False | +1 |
| True | True | 0 |

When both crew stations generate conflicting trim commands, the output trim command shall be zero.

2. If WOWLON_IND = 1
 - a. “OR” the selected negative pitch signals from both crew stations to produce a resultant negative pitch RHC command (Integer). Do not process the positive pitch, positive roll, or negative roll selected outputs and zero the resultant Roll RHC Command (Integer).

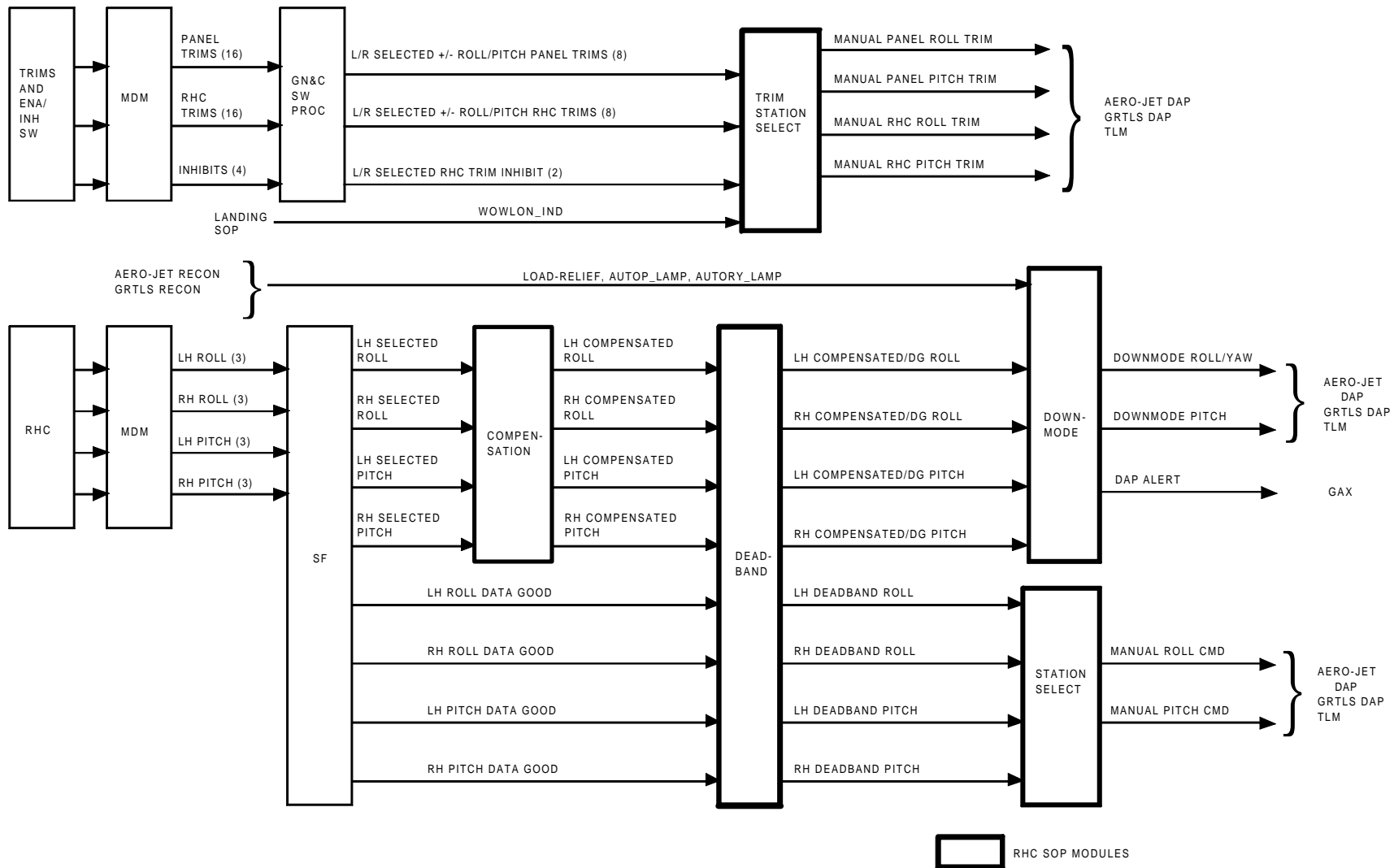


FIGURE 4.53-1. Two-Axis RHC SOP Functional Block Diagram

TABLE 4.53-2. INPUT FUNCTIONAL PARAMETERS FOR TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|------------------------|------------|---------------------------------|-------------|-------|--------------|------------------|---------|-------------|
| AUTOP_IND/AUTOP_LAMP | V90X1632XA | PITCH AUTO FLAG | AEROJET DAP | | | | 92522D | |
| AUTOP_IND/AUTOP_LAMP | V90X1632XB | PITCH AUTO FLAG | GRTLS DAP | | | | 92522D | |
| AUTORY_IND/AUTORY_LAMP | V90X1642XA | ROLL/YAW AUTO FLAG | AEROJET DAP | | | | 92522D | |
| AUTORY_IND/AUTORY_LAMP | V90X1642XB | ROLL/YAW AUTO FLAG | GRTLS DAP | | | | 92522D | |
| DISABL(1) | V90X7272XB | SEL LH RHC TRIM INHIBIT | GN&C SW RM | | | | 93017G | * |
| DISABL(2) | V90X7472XB | SEL RH RHC TRIM INHIBIT | GN&C SW RM | | | | 93017G | * |
| LOAD_RELIEF | V90X1643XA | LOAD RELIEF DISCRETE | AEROJET DAP | | | | 89120A | |
| LOAD_RELIEF | V90X1643XB | LOAD RELIEF DISCRETE | GRTLS DAP | | | | 89120A | |
| L_PIT_DG | V90X6033X | LEFT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| M/MACH | V95L3029C | GN&C MACH NUMBER | ADTA SOP | | SPL | | 93017G | * |
| PANATDS(1) | V90X7231X | SEL LH PANEL ROLL TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| PANATDS(2) | V90X7431X | SEL RH PANEL ROLL TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| PANATUS(1) | V90X7221X | SEL LH PANEL ROLL TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| PANATUS(2) | V90X7421X | SEL RH PANEL ROLL TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| PANETDS(1) | V90X7251X | SEL LH PANEL PITCH TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| PANETDS(2) | V90X7451X | SEL RH PANEL PITCH TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| PANETUS(1) | V90X7241X | SEL LH PANEL PITCH TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| PANETUS(2) | V90X7441X | SEL RH PANEL PITCH TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCATDS(1) | V90X7232X | SEL LH RHC ROLL TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCATDS(2) | V90X7432X | SEL RH RHC ROLL TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCATUS(1) | V90X7222X | SEL LH RHC ROLL TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCATUS(2) | V90X7422X | SEL RH RHC ROLL TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCETDS(1) | V90X7252X | SEL LH RHC PITCH TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCETDS(2) | V90X7452X | SEL RH RHC PITCH TRIM (-) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCETUS(1) | V90X7242X | SEL LH RHC PITCH TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| RHCETUS(2) | V90X7442X | SEL RH RHC PITCH TRIM (+) SW | GN&C SW RM | | BD | | 93017G | * |
| R_PIT_DG | V90X6133X | RIGHT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| WOWLON_IND | V96X0050X | WEIGHT ON MAIN WHEELS INDICATOR | LANDING SOP | | BD | | 93017G | * |
| | V90H6001C | SELECTED LEFT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6031C | SELECTED LEFT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6101C | SELECTED RIGHT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6131C | SELECTED RIGHT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90X6003X | LEFT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |
| | V90X6103X | RIGHT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.53-3. OUTPUT FUNCTIONAL PARAMETERS FROM TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|--------------|------------|-----------------------------|---|-------|-----------|---------|---------|-------|
| DACDB | V96H1027CA | LH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DAMAN/RHC(1) | V96H0005CA | MANUAL ROLL CMD | AEROJET DAP GRTLS DAP | DEG | | | | |
| DAPDB | V96H1026CA | RH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DAP_ALERT | V96X0041XA | RHC DAP DNMODE | GAX | | BD | | 90704F | |
| DATM_PAN | V96J1011C | MANUAL PANEL ROLL TRIM | AEROJET DAP GRTLS DAP | | | | | |
| DATM_RHC | V96J1054C | MANUAL RHC ROLL TRIM | TLM AEROJET DAP GRTLS DAP | | | | | |
| DECDB | V96H1025CA | LH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DEMAN/RHC(2) | V96H0007CA | MANUAL PITCH CMD | AEROJET DAP GRTLS DAP | DEG | | | | |
| DEPDB | V96H1024CA | RH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DETM_PAN | V96J1013C | MANUAL PANEL PITCH TRIM | AEROJET DAP GRTLS DAP | | | | | |
| DETM_RHC | V96J1053C | MANUAL RHC PITCH TRIM | TLM AEROJET DAP GRTLS DAP | | | | | |
| RHC_STATE(1) | V96J0015CB | RHC OUT OF DETENT ROLL | TLM AEROJET DAP GRTLS DAP | | | | 89740B | |
| RHC_STATE(2) | V96J0017CB | RHC OUT OF DETENT PITCH | SPTI SOP TLM AEROJET DAP GRTLS DAP | | | | 89740B | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
 (HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec

TABLE 4.53-4. TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-------------------------|-----------|-----------|----|----|---|---|---------------------------|----|-----|---------|-------------|
| CRHCPC | V97U3431C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCPP | V97U3432C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRC | V97U3434C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRP | V97U3435C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| DB1 | V97U3450C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB2 | V97U3451C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB3 | V97U3459C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHPCPC | V97U3595C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCPP | V97U3596C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRC | V97U3598C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRP | V97U3599C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| RHC_PTCH_DNMD_THLD | V97U3739C | DEG | F | S | D | P | G4.53 | 00 | ZSO | DC0813 | |
| RHC_PTCH_DNMD_THLD_LREL | V97U3738C | DEG | F | S | D | C | G4.53 | 00 | ZSO | DC0813 | |
| RHC_RY_DNMD_THLD | V97U3740C | DEG | F | S | D | P | G4.53 | 00 | ZSO | DC0813 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.53-5. TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.53-6. TWO-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.53) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--|-----------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
| RHCSSTP RHC PITCH SOFT STOP THRESHOLD | V97U3741C | 00 | +2.1171 | E+01 DEG | F | | S | P G4.53 | 90374C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.54 TRANSLATION HAND CONTROLLER SOP

The purpose of the Translation Hand Controller (THC) SOP shall be to perform the following functions:

- A. Transform the aft station THC commands from the $-X/-Z$ sense to the $+X$ sense, and
- B. Process forward THC and transformed aft THC commands to produce a resultant output command (station select).

These functions shall apply at the 6.25-Hz rate and shall be executed in the order stated above after GN&C SW RM and prior to ON-ORBIT DAP.

The THC SOP interfaces are indicated by the functional block diagram on Figure 4.54-1. The parameter initialization requirements are shown in Table 4.54-1. The IDD inputs and outputs are listed in Tables 4.54-2 and 4.54-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.54-4. K-loads are listed in Table 4.54-5. Constants are listed in Table 4.54-6.

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------|-----------|-----------------------|------------|-------------|---------------|-------|-------|
| THC(1) | V96J0401C | TRANS HAND CTRL X CMD | | INTEGER | 0 | | |
| THC(2) | V96J0402C | TRANS HAND CTRL Y CMD | | INTEGER | 0 | | |
| THC(3) | V96J0403C | TRANS HAND CTRL Z CMD | | INTEGER | 0 | | |

4.54.1 AFT THC Transformation

The transformation function shall consist of monitoring the $-X/-Z$ sense discrete from GN&C SW RM and transforming the aft THC signals.

When the sense discrete indicates the “1” state ($-X$ sense), then the aft THC translation signals shall be transformed 180 degrees in yaw and 90 degrees in roll. When the sense discrete indicates the “zero” state ($-Z$ sense), then the aft THC translation signals shall be transformed 180 degrees in yaw and $+90$ degrees in pitch and 90 degrees in roll. These transformations are defined as follows:

| Aft THC Inputs | Transformed Aft THC Outputs | |
|----------------|-----------------------------|------------|
| | $-X$ Sense | $-Z$ Sense |
| $+X$ | $-X$ | $-Z$ |
| $-X$ | $+X$ | $+Z$ |
| $+Y$ | $+Z$ | $-X$ |
| $-Y$ | $-Z$ | $+X$ |
| $+Z$ | $+Y$ | $+Y$ |
| $-Z$ | $-Y$ | $-Y$ |

4.54.2 THC Station Select

This function shall provide a station select process for the THC X, Y, and Z translation commands at both crew stations.

The station select process for the THC signals must be sequenced as follows:

A. "OR" a forward positive signal with a transformed aft positive signal to produce a resultant positive signal. "OR" a forward negative signal with a transformed aft negative signal to produce a resultant negative signal.

B. Convert resultant positive and negative signals from logical to integer format as shown below:

| Resultant Positive Signal | Resultant Negative Signal | X, Y, and Z Translation Commands (integer) |
|---------------------------|---------------------------|--|
| False | False | 0 |
| False | True | -1 |
| True | False | +1 |
| True | True | 0 |

When both crew stations generate conflicting translation commands, the output translation command shall be zero.

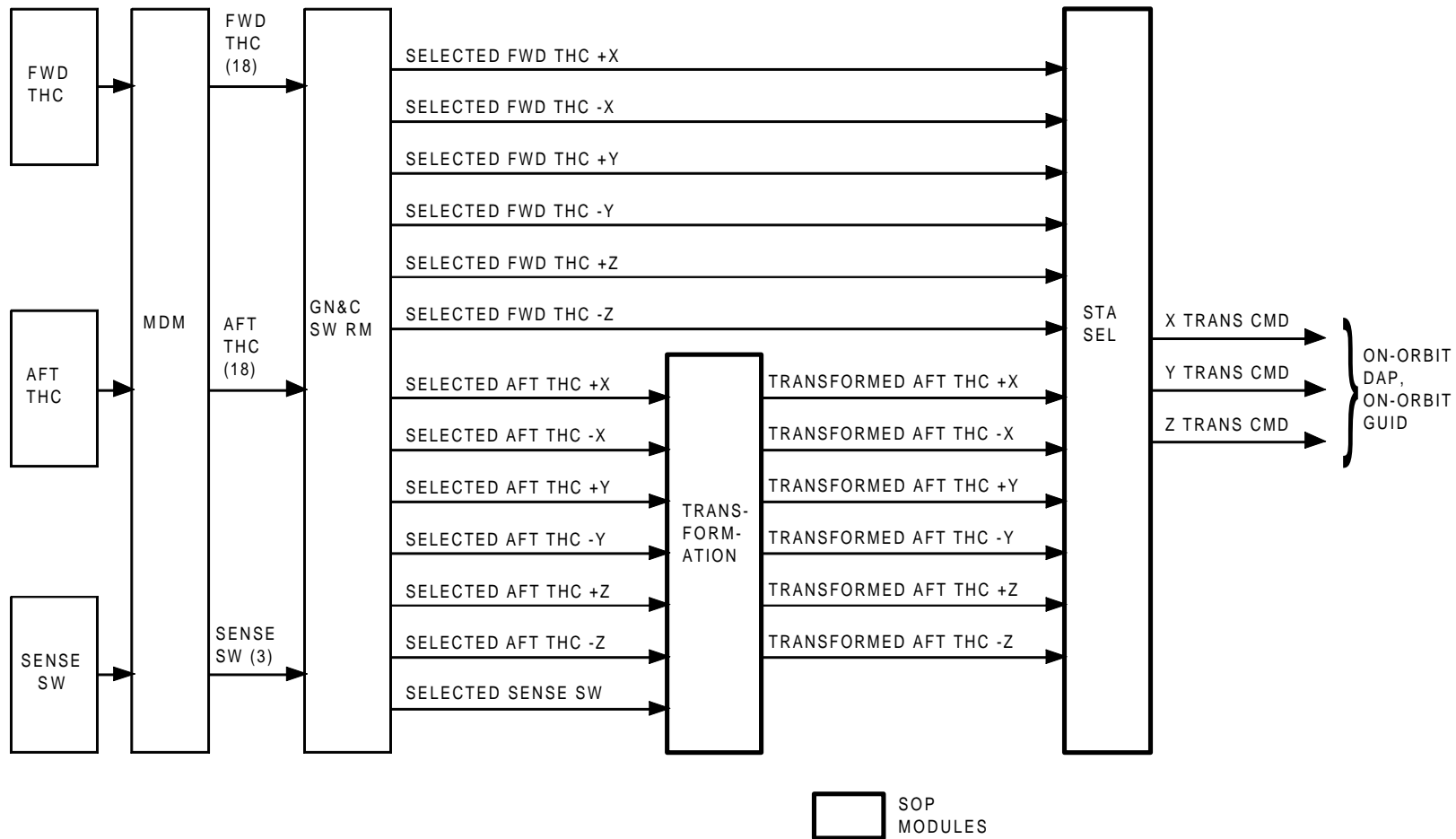


FIGURE 4.54-1. THC SOP Functional Block Diagram

TABLE 4.54-2. INPUT FUNCTIONAL PARAMETERS FOR TRANSLATION HAND CONTROLLER SOP (G4.54)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|------------|-----------|--------------------------|------------|-------|--------------|------------------|---------|-------------|
| SENSE_SW | V90X7700X | SEL SENSE -X | GN&C SW RM | | BD | | 93017G | * |
| THC_ASN(1) | V90X8145X | SEL AFT THC NEG X OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_ASN(2) | V90X8139X | SEL AFT THC NEG Y OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_ASN(3) | V90X8141X | SEL AFT THC NEG Z OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_ASP(1) | V90X8136X | SEL AFT THC POS X OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_ASP(2) | V90X8143X | SEL AFT THC POS Y OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_ASP(3) | V90X8140X | SEL AFT THC POS Z OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSN(1) | V90X7694X | SEL FWD THC NEG X OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSN(2) | V90X7695X | SEL FWD THC NEG Y OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSN(3) | V90X7696X | SEL FWD THC NEG Z OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSP(1) | V90X7697X | SEL FWD THC POS X OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSP(2) | V90X7698X | SEL FWD THC POS Y OUTPUT | GN&C SW RM | | BD | | 93017G | * |
| THC_FSP(3) | V90X7699X | SEL FWD THC POS Z OUTPUT | GN&C SW RM | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.54-3. OUTPUT FUNCTIONAL PARAMETERS FROM TRANSLATION HAND CONTROLLER SOP (G4.54)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|-----------------------|-------------|-------|-----------|------------------|---------|-------------|
| THC(1) | V96J0401C | TRANS HAND CTLR X CMD | ORB DAP | | ORB GUID | | | |
| THC(2) | V96J0402C | TRANS HAND CTLR Y CMD | ORB DAP | | ORB GUID | | | |
| THC(3) | V96J0403C | TRANS HAND CTLR Z CMD | ORB DAP | | ORB GUID | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.54-4. TRANSLATION HAND CONTROLLER SOP (G4.54) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.54-5. TRANSLATION HAND CONTROLLER SOP (G4.54) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.54-6. TRANSLATION HAND CONTROLLER SOP (G4.54) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.55 SPEED BRAKE THRUST CONTROLLER SOP

The purpose of the Speed Brake Thrust Controller (SBTC) SOP principal function shall be to perform the following functions:

- A. Compensation of the selected transducer commands by application of scale factors and biases.
- B. Processing of compensated signals for both crew stations to produce a speed brake output command (station select), and
- C. Generation of manual throttle settings in percent.

The SBTC SOP functions shall be processed at the 6.25 Hz rate for both crew stations. These functions shall be executed in the order stated above after Selection Filter and prior to AERO-JET DAP, GRTLS DAP, AS 1ST GUID, AS 2ST GUID, and PW RTLS GUID.

The SBTC SOP interfaces are indicated on the functional block diagram on Figure 4.55-1. The parameter initialization requirements are shown in Table 4.55-1. The IDD inputs and outputs are listed in Tables 4.55-2 and 4.55-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.55-4. K-loads are listed in Table 4.55-5. Constants are listed in Table 4.55-6.

No manual throttling for AEROJET/GRTLS is required since the main engines are not firing.

Table 4.55-1. SBTC SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|------------|-----------|------------------------------------|------------|-------------|---------------|-------------------------|---------|
| CSBTCC | V97U3447C | COMP SCALE FACTOR-LH SBTC | L | FLOAT PT | | +12.79873, +10.47873 | DEG/VDC |
| CSBTCP | V97U3448C | COMP SCALE FACTOR-RH SBTC | L | FLOAT PT | | +12.79873, +10.47873 | DEG/VDC |
| KSBTCC | V97U3633C | COMP BIAS-LH SBTC | L | FLOAT PT | | +0.89, -0.6 | DEG |
| KSBTCP | V97U3634C | COMP BIAS-RH SBTC | L | FLOAT PT | | +0.89, -0.6 | DEG |
| DTHROT_PER | V97U9000C | SBTC THROTTLE SCALE FACTOR | D | FLOAT PT | | | %/DEG |
| KMIN | V97U4425C | MINIMUM THROTTLE SETTING | D | FLOAT PT | | | % |
| KMAX | V97U4424C | MAXIMUM THROTTLE SETTING | D | FLOAT PT | | | % |
| EPS_THROT | V97U9001C | MANUAL THROTTLE MATCHING THRESHOLD | D | FLOAT PT | | | % |
| SBEV_LH | V96X0002X | CMDR SBTC TAKEOVER FLAG | | FLOAT PT | 1.0 | | |
| SBEV_RH | V96X0003X | PLT SBTC TAKEOVER FLAG | | FLOAT PT | 0.0 | | |

4.55.1 SBTC Compensation

The SBTC compensation function shall consist of applying scale factors and biases to convert the selected SBTC commands into engineering units (degrees) in floating point format. Provisions shall be made for unique scale factor and bias terms for each selected signal. The general compensation equation shall be as follows:

$$YC = YM C + K$$

where

- YC = Compensated signal (deg),
- YM = Selected measured signal (Vdc),
- C = Compensation scale factor (deg/Vdc), and
- K = Compensation bias (deg),

4.55.2 SBTC Station Select

The SBTC station select function shall select either the right or the left compensated SBTC signal, based on the SBTC takeover discrettes from GN&C SW RM and data good flags from Selection Filter.

The SBTC station select output command shall be chosen from the crew station whose takeover discrete most recently read depressed ("1") except if both commander and pilot SBTO switches are on, in which case the commander SBTC station is selected. If the selected crew station has a SBTC data good flag that is FALSE, then the output command will be held to the value of the past output command. The commander and pilot speed brake takeover (SBTO) switches are throughput to the AEROJET DAP or GRTLS DAP RECON except in the case where both are on. In this case, the commander's SBTO switch is throughput and the pilot's SBTO switch is turned off.

4.55.3 SBTC Manual Throttle Processing

SBTC manual throttle processing provides for takeover by the pilot of the main engine throttle control from the auto throttle commands generated by guidance, and return to auto throttling by either crewman. Manual throttle commands shall be generated from the RH SBTC controller position. Transfer of throttle command from guidance to the pilot shall require matching the takeover command with the auto throttle command before control is transferred. If a match is not achieved before the takeover button is released, throttle control shall be returned to guidance. The SBTC AUTO/MANUAL lamp discrettes shall be set to indicate the control state on the glareshield SBTC AUTO/MAN PBIs.

The detailed processing requirements are:

1. Speed brake/throttle controller setting. If the RH SBTC takeover button is depressed (SBEV_RH_SEL = ON) or the pilot has already assumed manual control (RH_SPDBK_MANUAL = ON), the RH speed brake/throttle controller compensated position (DSBTCPC) is converted into a throttle setting in percent RPL and limited to a value within the minimum and maximum throttle commands:

$$SBTHROT = KMAX - (DSBTCPC + 0.582) DTHROT_PER_DEG, \text{ and}$$
$$SBTHROT = MIDVAL (KMIN, ROUND (SBTHROT), KMAX),$$

where

SBTHROT = SBTC manual throttle setting
KMIN = Minimum throttle setting
KMAX = Maximum throttle setting
DTHROT_PER_DEG = SBTC throttle scale factor, and
DSBTCPC = RH compensated SBTC command

2. AUTO/MANUAL SBTC lamp discrettes. If in AUTO throttle control mode, the lamp discrettes shall be as follows:

LH_SPDBK_AUTO = ON
RH_SPDBK_AUTO = ON
LH_SPDBK_MANUAL = OFF
RH_SPDBK_MANUAL = OFF

If in MANUAL throttle control mode, the lamp discrettes shall be set as follows:

LH_SPDBK_MANUAL = OFF
RH_SPDBK_MANUAL = ON
LH_SPDBK_AUTO = OFF
RH_SPDBK_AUTO = OFF

3. Manual throttle commands shall be generated as follows:

If RH_SPDBK_MANUAL = ON and R_SBTC_DG = ON,
then K_CMD = SBTHROT.

4. Manual takeover. Manual takeover from auto throttling shall be initiated when the RH SBTC takeover button is depressed (SBEV_RH_SEL = ON). Depression of the SBTC takeover button by the pilot when in manual throttle control (SBEV_RH_SEL = ON and RH_SPDBK_MANUAL = ON) is not a valid takeover signal and shall have no effect. When a valid takeover signal occurs, and before throttle matching is achieved, all four SBTC AUTO/MAN lamp discrettes shall be set to OFF and the manual throttling discrete, S_MAN_THROT, shall be set ON. A valid takeover signal is defined by SBEV_RH_SEL = ON and RH_SPDBK_MANUAL = OFF. The manual throttle discrete S_MAN_THROT = ON shall freeze the throttle command at its last value before takeover until a throttle match is achieved. Takeover shall be enabled when the takeover manual throttle setting matches the last auto throttle command within a specified tolerance as follows:

If SBEV_RH_SEL = ON and $ABS(SBTHROT - K_CMD) < EPS_THROT$,
then RH_SPDBK_MANUAL = ON,

where

EPS_THROT = Manual throttle matching threshold.

STS 83-0015-34
December 14, 2007

The discrete S_MAN_THROT shall remain set to ON when matching is achieved. After matching is achieved, the RH SBTC takeover button can be released (set to OFF). If the RH SBTC takeover button is released before a throttle match is achieved, throttle control shall return to auto throttling; and the appropriate glareshield lamps shall be lit (see item 2 above) to indicate auto control state.

Setting RH_SPDBK_MANUAL to ON after K_CMD is set (Step 3) induces an acceptable one cycle lag (reference DR 109402).

5. Manual to auto throttling. Return to auto throttling from manual control shall be accomplished by depressing either SBTC AUTO/MAN PBI. Depressing either PBI shall cause the AUTOSB discrete to be set to ON as long as the PBI is depressed. If AUTOSB = ON, the glareshield lamp discrettes shall be set to the auto throttling configuration described in Item 2, and the discrete S_MAN_THROT shall be set to OFF. There is no throttle matching requirement for a return to auto throttle control. It is allowable to simplify the implementation of these requirements to inhibit the return to auto throttling when AUTOSB = ON if SBEV_RH_SEL = ON.

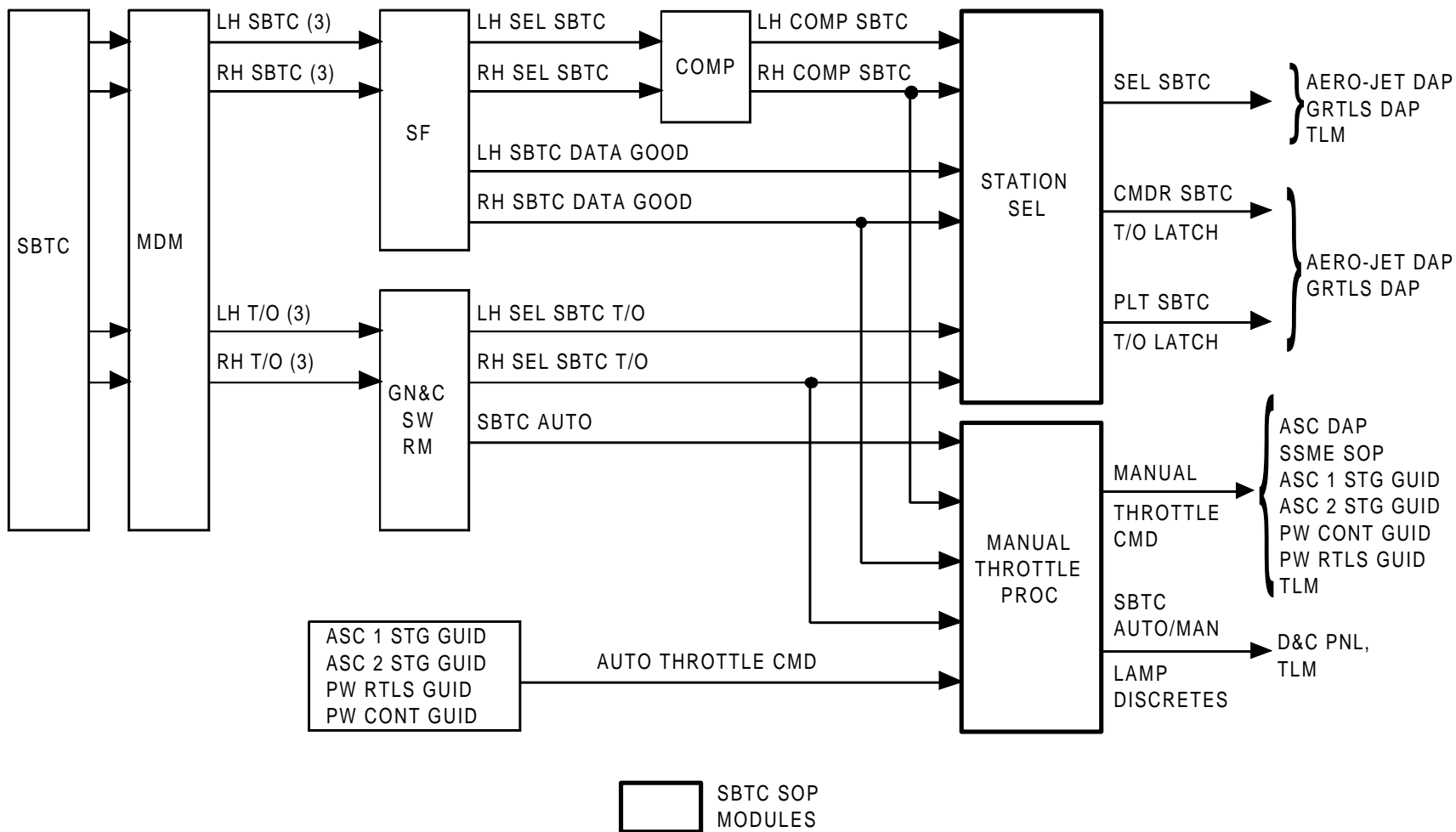


FIGURE 4.55-1. SBTC SOP Functional Block Diagram

TABLE 4.55-2. INPUT FUNCTIONAL PARAMETERS FOR SPEEDBRAKE THRUST CONTROLLER SOP (G4.55)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|--------------------|------------|------------------------------------|---------------|-------|--------------|------------------|---------|-------------|
| AUTOSB | V96X1052X | STATION SEL SPD BK/THROT AUTO/MAN | GN&C SW RM | | | | | |
| DSBTCC | V90H6801C | SELECTED LEFT SPEEDBRAKE CMD | SF | VDC | SPL | | 93017G | * |
| DSBTCP | V90H6901C | SELECTED RIGHT SPEEDBRAKE CMD | SF | VDC | SPL | | 93017G | * |
| KMAX | V97U4424CA | MAXIMUM THROTTLE SETTING OF SSME'S | ASC 1STG GUID | PCT | | | 90608D | |
| KMAX | V97U4424CB | MAXIMUM THROTTLE SETTING OF SSME'S | ASC 2STG GUID | PCT | | | 90608D | |
| KMAX | V97U4424CC | MAXIMUM THROTTLE SETTING OF SSME'S | PW RTLS GUID | PCT | | | 90608D | |
| KMAX | V97U4424CD | MAXIMUM THROTTLE SETTING OF SSME'S | PW CONT GUID | PCT | | | 90608D | |
| K_CMD | V90U1948CA | COMMANDED SSME THROTTLE SETTING | ASC 2STG GUID | PCT | | | 93017G | * |
| K_CMD | V90U1948CB | COMMANDED SSME THROTTLE SETTING | ASC 1STG GUID | PCT | | | 93017G | * |
| K_CMD | V90U1948CC | COMMANDED SSME THROTTLE SETTING | PW RTLS GUID | PCT | | | 93017G | * |
| K_CMD | V90U1948CF | COMMANDED SSME THROTTLE SETTING | PW CONT GUID | PCT | | | 93017G | * |
| MM_CODE_102/MM_102 | V90X8158X | MAJOR MODE 102 FLAG | MSC | | | | 93012D | |
| MM_CODE_104/MM_104 | V90X8152X | MAJOR MODE 104 FLAG | MSC | | | | 92355B | |
| MM_CODE_304/MM_304 | V90X8161X | MAJOR MODE 304 FLAG | MSC | | | | 92355B | |
| MM_CODE_602/MM_602 | V90X8174X | MAJOR MODE 602 FLAG | MSC | | | | 92355B | |
| SBEV_LH_SEL | V90X6810X | SEL LH SBTC TAKEOVER | GN&C SW RM | | BD | | 93017G | * |
| SBEV_RH_SEL | V90X6910X | SEL RH SBTC TAKEOVER | GN&C SW RM | | BD | | 93017G | * |
| | V90X2523X | LEFT SBTC CMD DATA GOOD | SF | | | | | |
| | V90X2524X | RIGHT SBTC CMD DATA GOOD | SF | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.55-3. OUTPUT FUNCTIONAL PARAMETERS FROM SPEEDBRAKE THRUST CONTROLLER SOP (G4.55)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|--------------|------------|---------------------------------|---|-------|-----------|---------|---------|-------|
| DSBMAN | V96H0001C | SEL MAN SPDBK CMD | AEROJET DAP GRTLS DAP TLM | DEG | | | | |
| K_CMD | V90U1948CE | COMMANDED SSME THROTTLE SETTING | ASC 1STG GUID ASC 2STG GUID ASC DAP PW CONT GUID PW RTLS GUID RTLS TRAJ 2 DISP SSME SOP XXXXXX TRAJ 1 DISP XXXXXX TRAJ 2 DISP | PCT | | | 93012D | |
| LAUTO_SBLAMP | V72X5136XA | LH SPEEDBRAKE AUTO | D&C PNL DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| MNLSB_CMDR_O | V72X5137XA | LH SPEEDBRAKE MANUAL | D&C PNL DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| MNLSB_PLT_O | V72X5135XA | RH SPEEDBRAKE MANUAL | D&C PNL DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| RAUTO_SBLAMP | V72X5134XA | RH SPEEDBRAKE AUTO | D&C PNL TLM | | | | | |
| SBEV_LH | V96X0002X | CMDR SBTC TAKEOVER FLAG | AEROJET DAP GRTLS DAP | | | | | |
| SBEV_RH | V96X0003X | PLT SBTC TAKEOVER FLAG | AEROJET DAP GRTLS DAP | | | | | |
| S_MAN_THROT | V96X0006X | MANUAL THROTTLE DISCRETE | ASC 1STG GUID ASC 2STG GUID DL FMT 21/A MEDS FC GNC XFER PW CONT GUID PW RTLS GUID | | BD | | 93017G | * |
| | V72M6630P | MDM FF01 DSCR OUT SET | CD 10 CH 0 DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| | V72M6680P | MDM FF02 DSCR OUT SET | CD 10 CH 0 DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| | V72M6780P | MDM FF04 DSCR OUT SET | CD 10 CH 0 DL FMT 21/A DL FMT 23/1 | | | | 93017G | * |
| | V90M2857PE | CGEB_IPA_LG2_FLAG_WD1_HFE | DL FMT 21/A | | | | 93017G | * |

TABLE 4.55-3. OUTPUT FUNCTIONAL PARAMETERS FROM SPEEDBRAKE THRUST CONTROLLER SOP (G4.55)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|--------|--------------|-------------|-------|--------------|------------------|---------|-------------|
|-----------|--------|--------------|-------------|-------|--------------|------------------|---------|-------------|

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.55-4. SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|----------------|-----------|-----------|----|----|---|---|---------------------------------------|----|-----|---------|-------------|
| CSBTCC | V97U3447C | DEG/VDC | F | S | D | A | G4.55 | 00 | ZFO | DC0599 | |
| CSBTCP | V97U3448C | DEG/VDC | F | S | D | A | G4.55 | 00 | ZFO | DC0599 | |
| DTHROT_PER_DEG | V97U9000C | PCT/DEG | F | S | D | P | G4.55 | 00 | ZSO | DC0813 | |
| EPS_THROT | V97U9001C | PCT | I | S | D | P | G4.55 | 00 | ZSO | DC0813 | |
| KMAX | V97U4424C | PCT | I | S | M | C | G4.1 G4.2 G4.4 G4.5 G4.55 | 00 | A2P | 89990E | |
| KMIN | V97U4425C | PCT | I | S | D | C | G4.2 G4.4 G4.55 | 00 | A2P | 89990E | |
| KSBTCC | V97U3633C | DEG | F | S | L | C | G4.55 | 00 | ZSO | DC0813 | |
| KSBTCP | V97U3634C | DEG | F | S | L | C | G4.55 | 00 | ZSO | DC0813 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.55-5. SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.55-6. SPEEDBRAKE THRUST CONTROLLER SOP (G4.55) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

4.56 RUDDER PEDAL TRANSDUCER ASSEMBLY SOP

The purpose of the Rudder Pedal Transducer Assembly (RPTA) SOP principal function shall be to perform the following functions:

- A. Compensation of the selected transducer commands by application of scale factors and biases,
- B. Processing of compensated signals for both crew stations to produce a resultant output command (station select),
- C. Processing of breakout deadbanding of the station selected signal, and
- D. Station selection of the yaw trim switches.

The RPTA SOP functions shall be processed for both crew stations at the 6.25 Hz rate for the RPTA and at the 6.25 Hz rate for the yaw trims. These functions shall be executed in the order stated above after Selection Filter (SF) and prior to AERO-JET DAP and GRTLS DAP.

The RPTA SOP interfaces are indicated on the functional block diagram on Figure 4.56-1. The parameter initialization requirements are shown in Table 4.56-1. The IDD inputs and outputs are listed in Tables 4.56-2 and 4.56-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.56-4. K-loads are listed in Table 4.56-5. Constants are listed in Table 4.56-6.

Table 4.56-1. RPTA SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|-------|-----------|---------------------------|------------|-------------|---------------|---------------------|---------|
| CRPTC | V97U3439C | COMP SCALE FACTOR—LH RPTA | L | FLOAT PT | | -4.0545, -4.9545 | DEG/VDC |
| CRPTP | V97U3440C | COMP SCALE FACTOR—RH RPTA | L | FLOAT PT | | -4.0545, -4.9545 | DEG/VDC |
| KRPTC | V97U3606C | COMP BIAS—LH RPTA | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRPTP | V97U3607C | COMP BIAS—RH RPTA | L | FLOAT PT | | +0.1, -0.1 | DEG |
| DRMDB | V97U3456C | RPTA BREAKOUT DEADBAND | D | FLOAT PT | | +1.235, +1.015 | DEG |
| DRMAN | V96H0009C | MANUAL YAW CMD | | FLOAT PT | 0.0 | | DEG |
| DRT | V96J1015C | MANUAL YAW TRIM CMD | | INTEGER | 0 | | |

4.56.1 RPTA Compensation

The RPTA compensation function shall consist of applying scale factors and biases to convert the selected RPTA commands into engineering units (degrees) in floating point format. Provisions shall be made for unique scale factor and bias terms for each selected signal. The general compensation equations shall be as follows:

$$YC = YM C + K$$

where

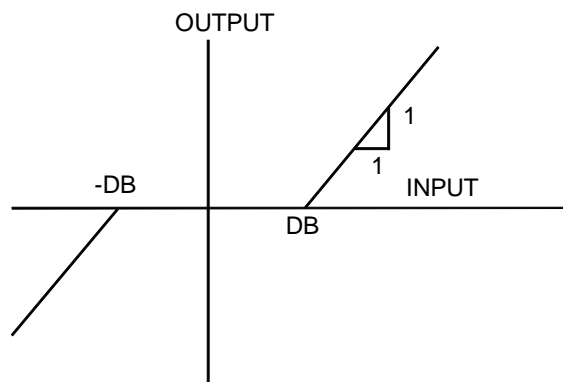
- YC = Compensated signal (deg),
- YM = Measured signal (Vdc)
- C = Compensation scale factor (deg/Vdc), and
- K = Compensation bias (deg).

4.56.2 RPTA Station Select

The RPTA station selection function shall select either the right or the left compensated RPTA signal, based on magnitude and data good flags from SF. If both RPTA data good flags are TRUE, then the compensated signal with the largest magnitude shall be selected. If the data good flag for one RPTA is FALSE (indicating a dilemma condition), then the compensated signal from the other side shall be selected. If both data good flags are FALSE, then the selected signal shall be set to “zero.”

4.56.3 RPTA Deadbanding

The RPTA deadbanding function shall apply a breakout deadband to the station selected RPTA signal for use by the AERO-JET DAP. The deadband shall be DRMDB degrees and is implemented as shown in the following diagram.



- For $|\text{INPUT}| < \text{DB}$, $\text{OUTPUT} = 0$;
- For $|\text{INPUT}| \geq \text{DB}$, $\text{OUTPUT} = \text{INPUT} - \text{DB SIGN}(\text{INPUT})$

4.56.4 YAW Trim Station Select

The yaw trim station select function shall provide a station select process for the panel yaw trim switches at each crew station.

The yaw trim station select process must be sequenced as follows:

- A. “AND” the left selected trim signals with the “NOT” of the selected left RHC trim inhibit signal to produce enabled left trim signals. “AND” the right selected trim signals with the “NOT” of the right RHC trim inhibit signal to produce enabled right trim signals.
- B. “OR” the enabled positive signals from both crew stations to produce a resultant positive signal. “OR” the enabled negative signals from both crew stations to produce a resultant negative signal.
- C. Convert resultant positive and negative signals from discrete to integer format as shown below:

| Resultant Positive Signal | Resultant Negative Signal | Yaw Command (integer) |
|---------------------------|---------------------------|-----------------------|
| False | False | 0 |
| False | True | -1 |
| True | False | +1 |
| True | True | 0 |

When both crew stations generate conflicting trim commands, the output trim command shall be “zero.”

This page intentionally left blank.

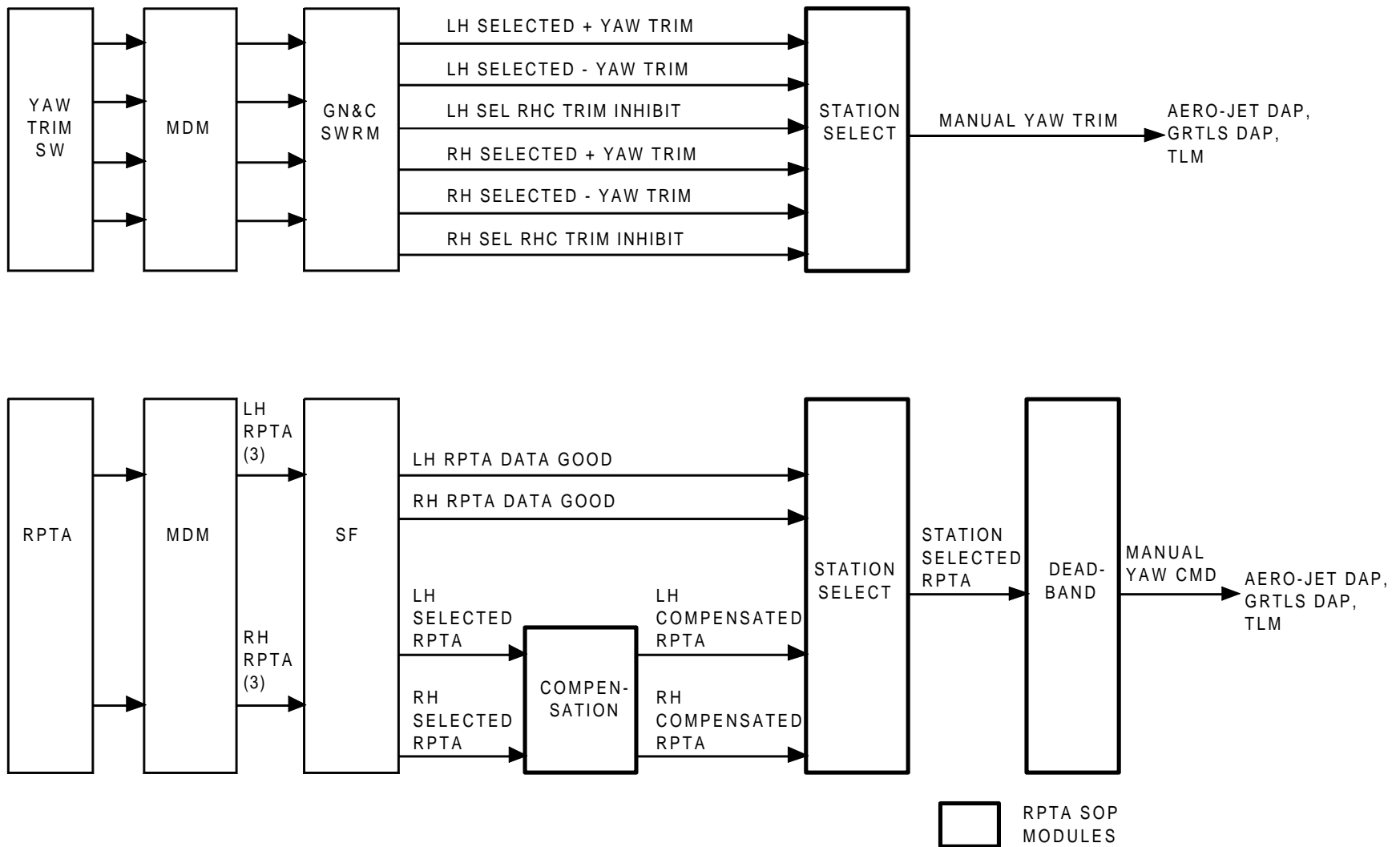


FIGURE 4.56-1. RPTA SOP Functional Block Diagram

TABLE 4.56-2. INPUT FUNCTIONAL PARAMETERS FOR RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|------------|-----------------------------|------------|-------|-----------|---------|---------|-------|
| DETYMS(1) | V90X7271X | SELECTED LH YAW (-) TRIM SW | GN&C SW RM | | BD | | 93017G | * |
| DETYMS(2) | V90X7471X | SELECTED RH YAW (-) TRIM SW | GN&C SW RM | | BD | | 93017G | * |
| DETYPS(1) | V90X7261X | SELECTED LH YAW (+) TRIM SW | GN&C SW RM | | BD | | 93017G | * |
| DETYPS(2) | V90X7461X | SELECTED RH YAW (+) TRIM SW | GN&C SW RM | | BD | | 93017G | * |
| DISABL(1) | V90X7272XB | SEL LH RHC TRIM INHIBIT | GN&C SW RM | | | | 93017G | * |
| DISABL(2) | V90X7472XB | SEL RH RHC TRIM INHIBIT | GN&C SW RM | | | | 93017G | * |
| | V90H4402C | SELECTED LEFT RPTA CMD | SF | VDC | SPL | | 93017G | * |
| | V90H4502C | SELECTED RIGHT RPTA CMD | SF | VDC | SPL | | 93017G | * |
| | V90X4413X | LEFT RPTA DATA GOOD | SF | | BD | | 93017G | * |
| | V90X4513X | RIGHT RPTA DATA GOOD | SF | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.56-3. OUTPUT FUNCTIONAL PARAMETERS FROM RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|---------------------|---------------------------------|-------|-----------|---------|---------|-------|
| DRMAN | V96H0009C | MANUAL YAW CMD | AEROJET DAP GRTLS DAP TLM | DEG | | | | |
| DRT | V96J1015C | MANUAL YAW TRIM CMD | AEROJET DAP GRTLS DAP TLM | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.56-4. RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
| CRPTC | V97U3439C | DEG/VDC | F | S | D | A | G4.56 | 00 | ZFO | DC0599 | |
| CRPTP | V97U3440C | DEG/VDC | F | S | D | P | G4.56 | 00 | ZFO | DC0599 | |
| DRMDB | V97U3456C | DEG | F | S | D | C | G4.56 | 00 | ZSO | DC0813 | |
| KRPTC | V97U3606C | DEG | F | S | L | C | G4.56 | 00 | ZSO | DC0813 | |
| KRPTP | V97U3607C | DEG | F | S | L | P | G4.56 | 00 | ZSO | DC0813 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.56-5. RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.56-6. RUDDER PEDAL TRANSDUCER ASSEMBLY SOP (G4.56) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.57 LANDING SOP

The purpose of the LANDING SOP principal function shall be to monitor the vehicle attitude, WOW initiate discrettes, and WOW discrettes to determine the status of the WOWLON, FLATTURN, ROLLOUT and nosewheel–steering discrettes. These functions shall be performed at the 6.25 Hz rate after GN&C SW RM and SF and LG WOW RM and prior to A/L GUID, AERO–JET DAP, E/L ADI PROC, GRTLS DAP, GRTLS A/L GUID, LDG GEAR VLV CNTL, and ADTA SOP.

The LANDING SOP principal function shall generate the landing discrettes as follows:

If EDO_HDW_UP indicates the “0” state (extended duration orbiter hardware upgrades not available), the LANDING SOP shall process the main gear discrettes (LMGNOWOW and RMGNOWOW) and the main gear COMMFAULTS as follows:

- If LMGNOWOW and RMGNOWOW both indicate the “1” state (no weight on main gear) and LMGCF and RMGCF indicate the “zero” state (no COMMFAULT), the WOW flag shall be set to the “zero” state (no weight on main gear) and the associated counters shall be reset; also the LMGNWBKV and RMGNWBKV flags shall be set to the “zero” state.
- If the WOW flag has not been set “on,” then the LMGNOWOW and RMGNOWOW are checked. If LMGNOWOW and RMGNOWOW indicate the “zero” state (weight on main gear) and LMGCF and RMGCF indicate the “zero” state (no COMMFAULT), then the LMGNWBKV and RMGNWBKV shall be set to the “1” state and the nose landing discrettes are checked. The nose landing discrettes are only checked if NLGCF1 and NLGCF2 indicate the “zero” state (no COMMFAULT).
 - If NLGCF1 or NLGCF2 indicates the “one” state, the WOW flag and its associated cycle counter are not updated on this pass.
 - If NLGNOWOW1 or NLGNOWOW2 indicates the “zero” state (weight on nose gear), then the WOW flag shall be set in the “zero” state and the WOW_DLMA flag shall be set TRUE.
 - If NLGNOWOW1 and NLGNOWOW2 indicate the “one” state (no weight on nose gear) and LMGNOWOW and RMGNOWOW both indicate the “zero” state of MG_AGREE number of cycles, then the WOW flag shall be set to the “one” state (weight on wheels).
- If LMGNOWOW and RMGNOWOW disagree and if both LMGCF and RMGCF indicate the “0” state (no COMMFAULT), the WOW flag shall be set to the “zero” state (no weight on main gear) and the WOW MG_AGREE counter shall be reset. If LMGNOWOW and RMGNOWOW disagree for MG_DISAGREE number of cycles, the WOW flag shall be latched to the “zero” state and the WOW_DLMA flag shall be set TRUE, the RMGNWBKV and LMGNWBKV discrettes shall be set to the opposite values of the corresponding RMGNOWOW and LMGNOWOW discrettes.
- If either LMGNOWOW or RMGNOWOW indicates the “zero” state (weight on main gear) on the first pass in MM 305 or 603, the WOW LMGNWBKV and RMGNWBKV flags shall be set and latched in the “zero” state and the WOW_DLMA flag shall be set TRUE;

STS 83-0015-34
December 14, 2007

- If either LMGCF or RMGCF indicates the “1” state (COMMFAULT), the WOW flag and its associated cycle counters are not updated on this pass.
- If either LMGCF or RMGCF indicates the “1” state (COMMFAULT), the corresponding LMGNWBKV or RMGNWBKV flags(s) and the associated cycle counters are not updated on this pass.

If EDO_HWD_UP indicates the “0” state, the nose landing gear discretely (NLGNOWOW1 AND NLGNOWOW2) and the nose landing gear COMMFAULTS shall be processed as follows:

- If NLGNOWOW1 and NLGNOWOW2 both indicate the “1” state (no weight on nose gear) and NLGCF1 and NLGCF2 indicate the “zero” state (no COMMFAULT), the WONG flag shall be set to the “zero” state (no weight on nose gear);
- If NLGNOWOW1 and NLGNOWOW2 both indicate the “zero” state (weight on nose gear), and NLGCF1 and NLGCF2 indicate the “zero” state (no COMMFAULT), the WONG flag shall be set to the “1” state (weight on nose gear);
- If NLGNOWOW1 and NLGNOWOW2 disagree and if both NLGCF1 and NLGCF2 indicate the “0” state (no COMMFAULT), the WONG flag shall be set to the “zero” state (no weight on nose gear). If NLGNOWOW1 and NLGNOWOW2 disagree for NG_DISAGREE number of cycles, the WONG flag shall be latched to the “zero” state;
- If either NLGNOWOW1 or NLGNOWOW2 indicates the “zero” state (weight on nose gear) on the first pass in MM 305 or 603, the WONG flag shall be set and latched in the “zero” state (no weight on nose gear);
- If either NLGCF1 or NLGCF2 indicates the “1” state (COMMFAULT), the WONG flag and its associated cycle counter are not updated on this pass.

The landing discretely shall be generated as follows (regardless of EDO_HDW_UP status):

- A. The WOW_INITIATE flag shall be set and latched in the “1” state (TRUE) if either the ET_SEP_INITIATE switch or the SRB_SEP_INITIATE switch indicates the “1” state (TRUE);
- B. The FLATTURN_CMD and HUD_WOWLON discretely shall be set and latched in the “1” state (TRUE) if either the WOW flag indicates the “1” state (weight on main gear) or the WOW_INITIATE flag indicates the “1” state (separation commanded);
- C. The WOWLON discrete shall be set and latched in the “1” state (TRUE) if the FLATTURN discrete indicates the “1” state;
- D. The ROLLOUT_IND and HUD_ROLLOUT discretely shall be set and latched in the “1” state (TRUE) if the WOWLON flag indicates the “1” state (weight on main gear) for T_WOW number of cycles and THETA is less than ATT_WONG, and either of the following conditions is met:
 - WONG flag indicates the “1” state (weight on nose gear), or
 - WOW_INITIATE flag indicates the “1” state (separation commanded);

E. The nosewheel ground speed enable (GSENL) discrete shall be set and latched in the “1” state (TRUE) if the ROLLOUT_IND discrete indicates the “1” state.

F. The BRAKE ISOLATION VALVE OPEN flag (BRK_VLV_OP) discrete shall be set and latched in the “1” state (true) if the LMGNWBKV output is true for T_WOW_BRAKE consecutive cycles or the RMGNWBKV output is true for T_WOW_BRAKE consecutive cycles or the MGBKV flag is true for T_WOW_BRAKE consecutive cycles or the WONG flag or the WOW_INITIATE flag is set true.

All landing discrettes shall be initialized in the FALSE state and latched in the TRUE state.

The LANDING SOP interfaces are indicated by the functional block diagram on Figure 4.57-1, and Table 4.57-1 lists the WOW discrete logic. The parameter initialization requirements are shown in Table 4.57-2. The IDD inputs and outputs are listed in Tables 4.57-3 and 4.57-4. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.57-5. K-loads are listed in Table 4.57-6. Constants are listed in Table 4.57-7.

This page intentionally left blank.

Table 4.57-1. WOW Discrete Logic

| Inputs | | | | Output | | |
|---|--------------------|---|--|--|-------------|-------------|
| LMGNOWOW/ LMGCF | RMGNOWOW/ RMGCF | NLGNOWOW1/ NLGCF1 | NLGNOWOW2/ NLGCF2 | WOW | LMGNWBKV | RMGNWBKV |
| 1 / 0 | 1 / 0 | - / - | - / - | 0 | 0 | 0 |
| 0 / 0 (LMGNOWOW = RMGNOWOW = 0 for MG_AGREE) (For WOW output only) | 0 / 0 | - / (0 or 1) (1 or 0) / 0 1 / 0 | - / (1 or 0) (0 or 1) / 0 1 / 0 | Not updated 0; WOW_DLMA = TRUE 1 | 1 | 1 |
| (1 or 0) / 0 | (0 or 1) / 0 | - / - | - / - | 0; WOW MG_AGREE reset | 0 or 1 | 1 or 0 |
| (1 or 0) / 0 (LMGNOWOW ≠ RMGNOWOW for MG_DISAGREE) (For WOW output only) | (0 or 1) / 0 | - / - | - / - | 0 (latched); WOW_DLMA = TRUE | 0 or 1 | 1 or 0 |
| 0 / 0 (true for first pass in MM 305 or 603) | or 0 / 0 | - / - | - / - | 0 (latched); WOW_DLMA = TRUE | 0 | 0 |
| (1 or 0) / 1 | (1 or 0) / 1 | - / - | - / - | Not updated | Not updated | Not updated |
| (1 or 0) / 1 | (1 or 0) / 0 | - / - | - / - | Not updated | Not updated | 0 or 1 |
| (1 or 0) / 0 | (1 or 0) / 1 | - / - | - / - | Not updated | 0 or 1 | Not updated |
| | | | | WONG | | |
| | | 1 / 0 0 / 0 (1 or 0) / 0 (NLGNOWOW1 ≠ NLGNOWOW2 for NG_DISAGREE) 0 / 0 or (True for first pass in MM 305 or 603) (1 or 0) / (1 or 0) | 1 / 0 0 / 0 (0 or 1) / 0 0 / 0 (1 or 0) / (0 or 1) | 0 1 0 0 (latched) 0 (latched) Not updated | | |

Note: Output FALSE and WOW_DLMA TRUE if NLGNOWOW1 or NLGNOWOW2 FALSE before WOWLON TRUE, or if LMGNOWOW and RMGNOWOW differ with no associated commfaults for MG_DISAGREE cycles. Output TRUE if WOW inputs TRUE for MG_AGREE cycles.

This page intentionally left blank.

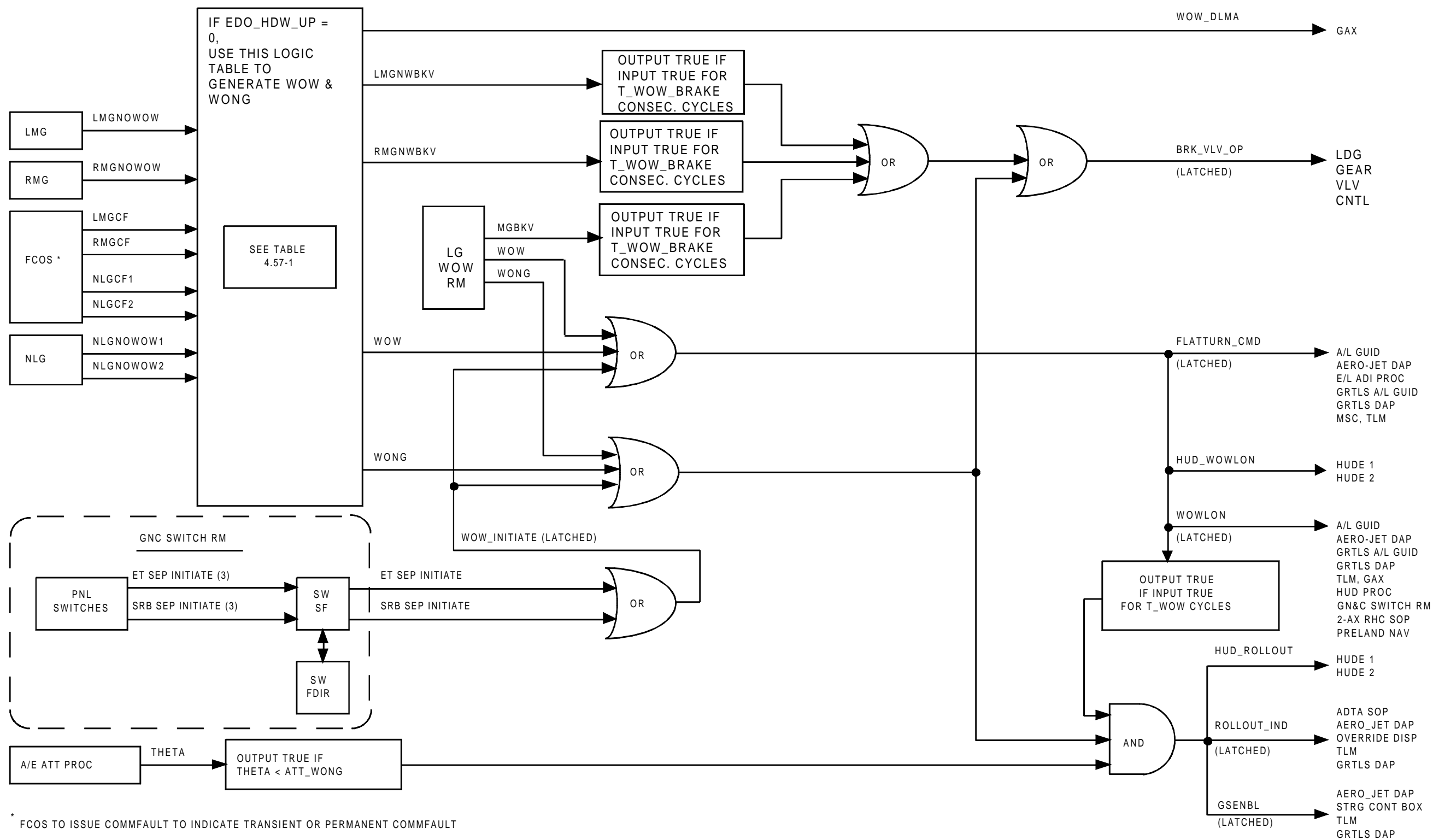


FIGURE 4.57-1. Landing SOP Functional Block Diagram

This page intentionally left blank.

| Table 4.57-2. Landing SOP Initialization Parameters | | | | | | | |
|---|-----------|--|--------|-------------|---------------|-------|--------|
| Name | MSID/MML | Description | Source | Signal Type | Nominal Value | Range | Units |
| FLATTURN | V96X0051X | FLATTURN INDICATOR | | DISCRETE | 0 | | |
| GSENL | V51K0608X | GROUND SPEED ENBL CMD-N/W STRG | | DISCRETE | 0 | | |
| ROLLOUT_IND | V96X0052X | ROLLOUT FLAG | | DISCRETE | 0 | | |
| WOWLON | V96X0050X | WEIGHT ON MAIN WHEELS INDICATOR | | DISCRETE | 0 | | |
| WOW_INITIATE | | MANUAL WOW/WONG INITIATE COMMAND | | DISCRETE | 0 | | |
| MG_AGREE | V98U7951C | MAIN GEAR BOUNCE DELAY THRESHOLD | K-LOAD | INTEGER | +6 | | CYCLES |
| MG_DISAGREE | V98U7952C | MAIN GEAR WOW DISAGREE CYCLE THRESHOLD | K-LOAD | INTEGER | +45 | | CYCLES |
| NG_DISAGREE | V98U7953C | NOSE GEAR WOW DISAGREE CYCLE THRESHOLD | K-LOAD | INTEGER | +20 | | CYCLES |
| T_WOW | V98U7954C | DELAY TIME BETWEEN WOWLON AND ROLLOUT INITIATE | K-LOAD | INTEGER | +1 | | CYCLES |
| ATT_WONG | V98U7955C | THETA FOR WONG INITIATE THRESHOLD | K-LOAD | FLOAT PT | +0.0 | | DEG |
| T_WOW_BRAKE | V97U4275C | DELAY TIME BETWEEN LMGNWBKV, RMGNWBKV AND BRAKE ISO VLV OPEN CMD INITIATE | I-LOAD | INTEGER | | | CYCLES |
| BRK_VLV_OP | V96X0060X | BRAKE ISO VLV OPEN FLAG | | DISCRETE | 0 | | |
| EDO_HDW_UP | V97U9645C | EDO HARDWARE UPGRADES | I-LOAD | DISCRETE | | | |

TABLE 4.57-3. INPUT FUNCTIONAL PARAMETERS FOR LANDING SUBSYSTEM OPERATING PROGRAM (G4.57)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|------------------|-----------|------------------------------------|--------------|-------|--------------|------------------|---------|-------------|
| LMGCF | V91X8114X | LEFT MAIN GEAR NO WOW COMMFAULT | FCOS | | BD | | 90112E | |
| LMGNOWOW | V51X0130X | LMG NO WEIGHT-ON-WHEELS | LCA F2 | | BD | | 93017G | * |
| MGBKV | V96X0242X | MAIN GEAR BRAKE ISO VALVE DISCRETE | LG WOW RM | | BD | | 90112E | |
| NLGCF1 | V91X8116X | NOSEGEAR NO WOW 1 COMMFAULT | FCOS | | BD | | 90112E | |
| NLGCF2 | V91X8117X | NOSEGEAR NO WOW 2 COMMFAULT | FCOS | | BD | | 90112E | |
| NLGNOWOW1 | V51X0330X | NLG NO WEIGHT-ON-WHEELS NO 1 | LCA F3 | | BD | | 93017G | * |
| NLGNOWOW2 | V51X0335X | NLG NO WEIGHT-ON-WHEELS NO 2 | LCA F2 | | BD | | 93017G | * |
| RMGCF | V91X8115X | RIGHT MAIN GEAR NO WOW COMMFAULT | FCOS | | BD | | 90112E | |
| RMGNOWOW | V51X0230X | RMG NO WEIGHT-ON-WHEELS | LCA F3 | | BD | | 93017G | * |
| THETA/THETA_TOPO | V90H2217C | BODY PITCH ATTITUDE EULER ANGLE | A/E ATT PROC | DEG | SPL | | 93017G | * |
| WONG | V96X0241X | WEIGHT ON NOSE GEAR | LG WOW RM | | BD | | 90112E | |
| WOW | V96X0240X | WEIGHT ON MAIN GEAR | LG WOW RM | | BD | | 90112E | |
| | V90X7564X | SEL ET SEP INITIATE/WOW-WONG CMD | GN&C SW RM | | BD | | 93017G | * |
| | V90X7572X | SEL SRB SEP INITIATE/WOW-WONG CMD | GN&C SW RM | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.57-4. OUTPUT FUNCTIONAL PARAMETERS FROM LANDING SUBSYSTEM OPERATING PROGRAM (G4.57)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|----------------------------|-------------------------------------|--|--|-------|-----------|---------|------------------|--------|
| BRK_VLV_OP FLATTURN_CMD | V96X0060X V96X0051X | BRAKE ISO VLV OPEN FLAG FLATTURN INDICATOR | LDG GEAR VLV CNTL A/L GUID AEROJET DAP GRTLS A/L GUID GRTLS DAP TLM | | BD | | 90102D | |
| GSENB | V90X2554X | GROUND SPEED ENBL CMD - NWS | AEROJET DAP DL FMT 21/A DL FMT 23/A GRTLS DAP MSC NW POSN SOP | | BD | | 93017G | * |
| HUD_ROLLOUT | V72X4035X | HUD ROLLOUT FLAG | HUDE1 HUDE2 | | BD | | | |
| HUD_WOWLON | V72X4034X | HUD WEIGHT ON MAIN WHEELS IND | HUDE1 HUDE2 | | BD | | | |
| ROLLOUT_IND | V96X0052X | ROLLOUT FLAG | ADTA SOP AEROJET DAP GRTLS DAP OVERRIDE DISP TLM | | | | 90102D | |
| WOWLON_IND | V96X0050X | WEIGHT ON MAIN WHEELS INDICATOR | 2-AX RHC SOP A/L GUID AEROJET DAP DL FMT 23/1 E/L ADI PROC E/L EV AN PROC GAX GN&C SW RM GRTLS A/L GUID GRTLS DAP HUD PROC MEDS FC GNC XFER MSC PRELAND NAV | | BD | | 93017G | * |
| WOW_DLMA | V96X0054X V94M3055P V96M0141P | A/N GATE LATCHED TO NULL CGCB_MC163_FLAG_3 CGCB_MC163_FLAG_1 | GAX DL FMT 21/A DL FMT 23/A DL FMT 23/1 | | | | 93017G 93017G | * * |

TABLE 4.57-4. OUTPUT FUNCTIONAL PARAMETERS FROM LANDING SUBSYSTEM OPERATING PROGRAM (G4.57)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|--------|--------------|-------------|-------|--------------|------------------|---------|-------------|
|-----------|--------|--------------|-------------|-------|--------------|------------------|---------|-------------|

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.57-5. LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-------------|-----------|-----------|----|----|---|---|-----------------|----|-----|---------|-------------|
| EDO_HDW_UP | V97U9645C | ND | D | | D | C | G4.243 G4.57 | 00 | ZF9 | DC2453 | |
| T_WOW_BRAKE | V97U4275C | CYCLES | I | S | D | C | G4.57 | 00 | NWS | 90102D | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.57-6. LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|---|-----------|----|-------------|-----------|----|--------|---|-------------------|---------|-------------|
| ATT_WONG THETA FOR WONG INITIATE THRESHOLD | V98U7955C | 00 | +0.0 | E+00 DEG | F | | S | C G4.243 G4.57 | 90112E | |
| MG_AGREE MAIN GEAR WOW AGREE CYCLE THRESHOLD | V98U7951C | 00 | +6 | CYCLES | I | | S | C G4.57 | 59959 | |
| MG_DISAGREE MAIN GEAR WOW DISAGREE CYCLE THRESH | V98U7952C | 00 | +45 | CYCLES | I | | S | C G4.57 | 79564 | |
| NG_DISAGREE NOSE GEAR WOW DISAGREE CYCLE THRESH | V98U7953C | 00 | +20 | CYCLES | I | | S | C G4.57 | 90060 | |
| T_WOW DELAY BETWEEN WOWLON-ROLLOUT INIT | V98U7954C | 00 | +1 | CYCLES | I | | S | C G4.57 | 79673 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.57-7. LANDING SUBSYSTEM OPERATING PROGRAM (G4.57) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

4.59 NOSE WHEEL POSITION SOP

The NW POSITION SOP is required to operate with the upgraded nose wheel steering system and to maintain compatibility with the nose wheel steering without the upgrade. The upgrade replaces the NWS direct mode with a second GPC mode like the first GPC mode and deletes the hardware fault logic. The I-Load “MODIFIED_NWS” is set ON (TRUE) for operation with the upgraded system and set OFF (FALSE) for operation without the upgrade.

The purpose of the Nose Wheel Position SOP principal function shall be to perform the following functions:

- A. Compensation of the selected transducer position feedback signal by application of scale factor and bias,
- B. Processing of the signal comparison between the commanded nose wheel position and the actual nose wheel position,
- C. Interrupt the output processing of a latched ground speed enable discrete if the comparison (B above) is out of tolerance, and
- D. Output the discrete to annunciate “NWS FAIL”, on interruption of the ground speed enable discrete and output the selected nose wheel position angle for initialization of NOSE WHEEL CMD FADER.

The Nose Wheel Position SOP functions shall be processed at the 25 Hz rate. These functions shall be executed in the order stated above after Selection Filter (SF) and before AERO-JET DAP, GRTLS DAP, and Landing SOP in Major Modes 603 and 305.

The Nose Wheel (NW) Position SOP function shall generate the nose wheel parameters as follows:

- * If this is the first pass for the NW Position SOP, the following shall be processed:
 - Direction and rate counters set to 0
 - ERROR FLAG = False
 - MODE FLAG = False
 - The difference and position filters will be initialized as set in Section 4.59.4.
- * Determination of the states of the NWS1 mode flag and the NWS2 mode flag shall be performed as detailed by Section 4.59.2.
- * Nose Wheel Position Compensation shall be done as detailed by Section 4.59.1. Position data and difference data (DNWC – COMP_NW_POSN) shall each be filtered through a first-order filter. The position and difference filters are described in Section 4.59.4
- * Nose Wheel Position Comparison shall be performed as shown in Section 4.59.3.
- * Last pass filtered COMP_NW_POSN (POSN Z⁻¹) will be set to present filtered COMP_NW_POSN (POSN).

A reference flow diagram of the NW POSITION SOP can be seen in Figure 4.59-4.

The Nose Wheel Position SOP interfaces are indicated in the functional block diagram on Figure 4.59–1. The nose wheel position SOP I-loads are shown in Table 4.59–1. The NWS mode interpretation logic is shown in Table 4.59–2. Table 4.59–3 shows the position filter initialization requirements. Table 4.59–4 shows the difference filter initialization requirements.

4.59.1 Nose Wheel Position Compensation

The Nose Wheel Position compensation function shall consist of applying a scale factor to convert the selected nose wheel position signal into engineering units (degrees) in floating point format. Provisions shall be made for unique scale factor and bias terms for the selected nose wheel position signal. The general compensation equation shall be as follows:

$$YC = (YM/C) + K$$

where

YC = COMP_NW_POSN (deg)

C = NW_POSN_SF (Vdc/deg)

YM = SEL_NW_POSN (Vdc)

K = NW_POSN_BIAS (deg)

4.59.2 Nose Wheel Position COMMFAULT Logic

The NWS1_MODE_FLAG and NWS2_MODE_FLAG shall be mutually exclusive for the true condition. The input conditions of the NWS1, NWS2, NWS_ACT_1, NWS_ACT_2, and COMMFAULT status for each of the discretes shall be interpreted as specified in Table 4.59–2. After the NWS1_MODE_FLAG is set TRUE, it shall remain TRUE until NWS2_MODE_FLAG is set TRUE per input conditions specified in Table 4.59–2. After the NWS2_MODE_FLAG is set TRUE it shall remain TRUE until the NWS1_MODE_FLAG is set true per input conditions specified in Table 4.59–2.

4.59.3 Nose Wheel Position Comparison

If either NWS1_MODE_FLAG or NWS2_MODE_FLAG changes from false to true, then the direction and rate counters shall be reset to zero, the difference filter shall be initialized as specified in Section 4.59.4, and MODE_FLAG shall be set to true on that pass. No NWS position comparison is done on that pass and the system remains failed that pass unless NWS2_MODE_FLAG is true and MODIFIED_NWS is false (unmodified system in direct mode). Otherwise the nose wheel position comparison function is done when the NWS1_MODE_FLAG is true or when the NWS2_MODE_FLAG is TRUE and MODIFIED_NWS = TRUE. Two forms of comparison checks shall be included: those for improper directional tracking and those for slow rate response.

An error flag for directional tracking is set when both of the following conditions are true for more than NW_DIR_LIM number of consecutive cycles:

- * The absolute value of the filtered (DNWC – COMP_NW_POSN) is greater than the tolerance (NW_POSN_TOL). (Note: Initialization for Difference filter will make the filtered (DNWC – COMP_NW_POSN) equal to zero on the first pass or when a new channel is selected.)

- * The filtered COMP_NW_POSN minus POSN Z multiplied by the filtered (DNWC – COMP_NW_POSN) is less than zero. (Note: POSN Z is equal to the last pass filtered COMP_NW_POSN.)

An error flag for the rate tracking is set when the three following conditions are true for more than NW_RATE_LIM number of consecutive cycles:

- * The absolute value of the filtered (DNWC – COMP_NW_POSN) is greater than the tolerance (NW_POSN_TOL). (Note: Initialization for difference filter will make the filtered (DNWC – COMP_NW_POSN) equal to zero on the first pass or when a new channel is selected.)
- * The filtered COMP_NW_POSN minus POSN Z multiplied by the filtered (DNWC – COMP_NW_POSN) is greater than or equal to zero. (Note: POSN Z is equal to the last pass filtered COMP_NW_POSN.)
- * The absolute value of the filtered COMP_NW_POSN minus POSN Z is less than NW_MIN_RATE.

Either a directional tracking error condition or a rate tracking error condition shall cause the ERROR_FLAG to be TRUE. Otherwise the ERROR_FLAG shall be FALSE. If the NWS2_MODE_FLAG is TRUE and MODIFIED_NWS equals FALSE, then the ERROR_FLAG shall be FALSE.

If the ERROR_FLAG is true, the NWP_ERR discrete shall be set TRUE and the NWS_ENA_A1_CMD, NWS_ENA_B1_CMD, NWS_ENA_A2_CMD and NWS_ENA_B2_CMD discrettes shall be set FALSE. Otherwise the NWP_ERR discrettes shall be set FALSE and the NWS_ENA_A1_CMD, NWS_ENA_B1_CMD, NWS_ENA_A2_CMD and NWS_ENA_B2_CMD discrettes shall be set TRUE.

If MODE_FLAG = TRUE, the MODE_FLAG shall be reset to false and the ERROR_FLAG shall be reset to false.

The IDD inputs and outputs are listed in Tables 4.59–5 and 4.59–6. Values for the I–loads are contained in the I–load requirements document (JSC–19350); however, I–load definitions applicable to this principal function are listed in Table 4.59–7. K–loads are listed in Table 4.59–8. Constants are listed in Table 4.59–9.

| Table 4.59-1. Nose Wheel Position SOP I-Loads | | | | |
|---|-----------|--|-----------|---------|
| Name | MSID | Description | Data Type | Units |
| NW_POSN_SF | V99U9701C | Nose wheel position comp scale factor | F | Vdc/deg |
| NW_POSN_BIAS | V99U9702C | Nose wheel position bias | F | deg |
| NW_POSN_TOL | V99U9703C | Nose wheel comparison check trip limit value | F | deg |
| NW_DIR_LIM | V99U9704C | Number of consecutive counts of directional error detected before failure declared | I | counts |
| NW_MIN_RATE | V99U9705C | Rate limit check minimum tolerance value | F | deg |
| NW_RATE_LIM | V99U9706C | Number of consecutive counts of rate error before failure declared | I | counts |
| KNWD1 | V99U9707C | Filter coefficient | F | ND |
| KNWD2 | V99U9708C | Filter coefficient | F | ND |
| KNWD3 | V99U9709C | Filter coefficient | F | ND |
| KNWR1 | V99U9710C | Filter coefficient | F | ND |
| KNWR2 | V99U9711C | Filter coefficient | F | ND |
| KNWR3 | V99U9712C | Filter coefficient | F | ND |
| MODIFIED_NWS | V97U1471C | NWS upgrade status | D | ND |

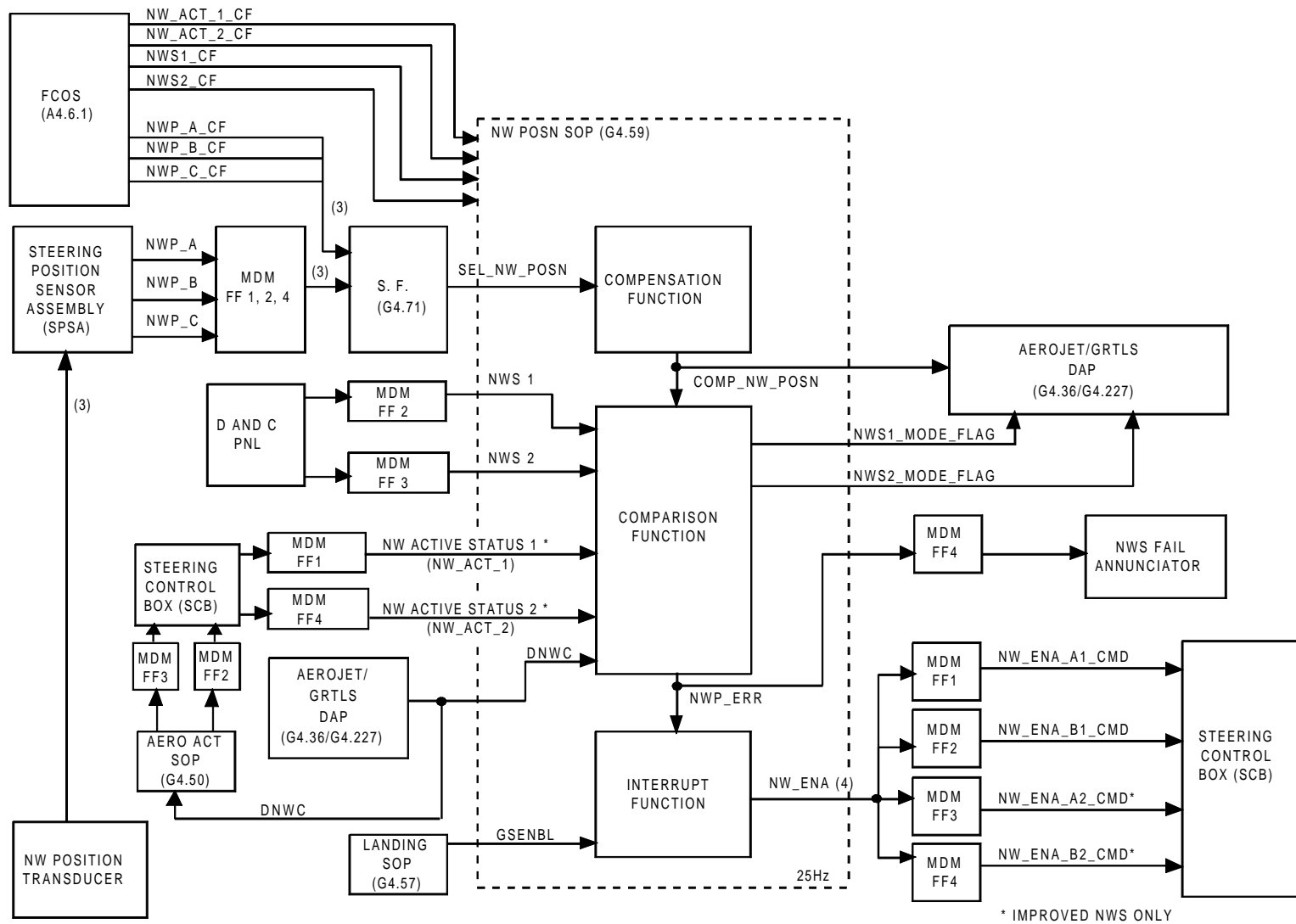


FIGURE 4.59-1. Nose Wheel Position SOP Functional Block Diagram

This page intentionally left blank.

4.59.4 Nose Wheel Position and Difference Filters

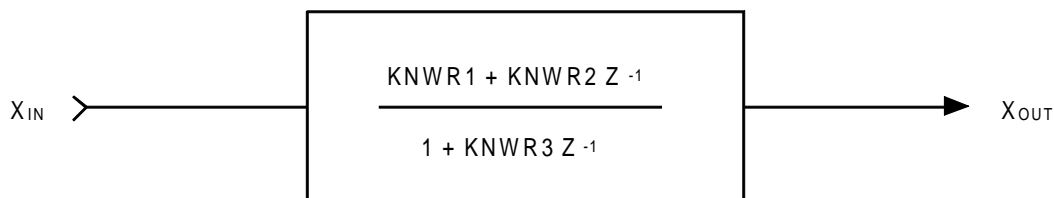
The function of the position filter is to apply a first-order filter to the compensated nose wheel position. The position filter is illustrated in Figure 4.59-2.

The I-loads for the position filter are also shown in Table 4.59-1, and the initialization requirements are detailed in Table 4.59-3.

The function of the difference filter is to apply a first-order filter to the difference between the NW command and the compensated NW position. The difference filter is shown in Figure 4.59-3.

The I-loads for this filter are shown in Table 4.59-1, and the initialization requirements are shown in Table 4.59-4.

The NW Position SOP flow is presented in Figure 4.59-4.



X_{IN} = COMPENSATED NOSE WHEEL POSITION (COMP_NW_POSN)

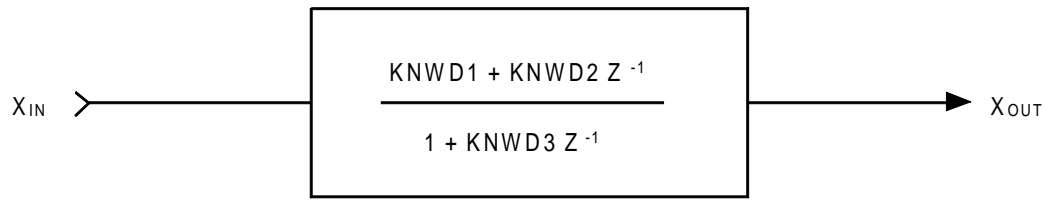
X_{OUT} = POSN = FILTERED COMPENSATED NOSE WHEEL POSITION

NODAL IMPLEMENTATION, AND OPERATING EQUATIONS:

$$X_{OUT} = NODE + X_{IN} (KNWR1)$$

$$NODE = X_{IN} (KNWR2) - X_{OUT} (KNWR3)$$

FIGURE 4.59-2 Position Filter



$$X_{IN} = (DNWC - COMP_NW_POSN)$$

$$X_{OUT} = DIFFERENCE = FILTERED (DNWC - COMP_NW_POSN)$$

NODAL IMPLEMENTATION AND OPERATING EQUATIONS:

$$X_{OUT} = NODE + X_{IN} (KNWD1)$$

$$NODE = X_{IN} (KNWD2) - X_{OUT} (KNWD3)$$

FIGURE 4.59-3 Difference Filter

Table 4.59-2. NWS Mode Interpretation Table

| COMMFault STATE | | | | | SIGNAL STATE | | | | MODE FLAGS | |
|-----------------|-----------------|------------|--------------------|--------------------|--------------|------|--------------|--------------|-----------------------------------|-----------------------------------|
| | NWS1 CF | NWS2 CF | NWS ACT 1 CF | NWS ACT 2 CF | NWS1 | NWS2 | NWS ACT 1 | NWS ACT 2 | NWS 1 NEW / OLD HDWR / HDWR | NWS 2 NEW / OLD HDWR / HDWR |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 1 | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | X | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | X | 0 | 0 |
| 6 | 0 | 0 | X | X | 1 | 0 | X | X | 1 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| 8 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | X | 1 | 0 |
| 9 | 0 | 0 | X | 0 | 1 | 1 | X | 0 | 1 | 0 |
| 10 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | X | 1 | 0 |
| 11 | 0 | 1 | 0 | 0 | 0 | X | 1 | 0 | 1 | 0 |
| 12 | 0 | 1 | X | X | 1 | X | X | X | 1 | 0 |
| 13 | 1 | 0 | 0 | X | X | 0 | 1 | X | 1 | 0 |
| 14 | 1 | 0 | 1 | 0 | X | 0 | X | 0 | 1 | 0 |
| 15 | 1 | 1 | 0 | 0 | X | X | 1 | 0 | 1 | 0 |
| 16 | 0 | 0 | X | X | 0 | 1 | X | X | 0 | 1 |
| 17 | 1 | 0 | X | X | X | 1 | X | X | 0 | 1 |
| 18 | 0 | 1 | X | 0 | 0 | X | X | 1 | 0 | 1 |
| 19 | ALL OTHER CASES | | | | | | | | 0 / 1 | 1 / 0 |

0: OFF 1: ON X: ANY
If MODIFIED_NWS = FALSE then NWS1 is equivalent to GPC Mode and NWS2 is equivalent to DIRECT Mode.

Table 4.59-3. Position Filter Initialization Requirements**

| Component | Initialize on Transition | | Variable | Initial Value |
|-----------------|-----------------------------|---------|----------|---------------|
| | From | To | | |
| Position filter | $\overline{\text{GSENB L}}$ | GSENB L | NODE | * |

*TEMP = ((KNWR1 + KNWR2)/(1 + KNWR3)) XIN
NODE = XIN (KNWR2) – TEMP (KNWR3)
**See Section 4.9.1, FSSR 7 (STS 83–0007), for a detailed discussion of first–order filters.

| Table 4.59-4. Difference Filter Initialization Requirements** | | | | |
|--|-----------------------------|---------|-------------|---------------|
| Component | Initialize on Transition | | Variable | Initial Value |
| | From | To | | |
| Difference filter | $\overline{\text{GSENB L}}$ | GSENB L | XIN NODE | 0.0 0.0 |
| Difference filter | $\overline{\text{NWS1}}$ | NWS1 | NODE | 0.0 |
| Difference filter | $\overline{\text{NWS2}}$ | NWS2 | NODE | 0.0 |
| **See Section 4.9.1, FSSR 7 (STS 83-0007), for a detailed discussion of first-order filters. | | | | |

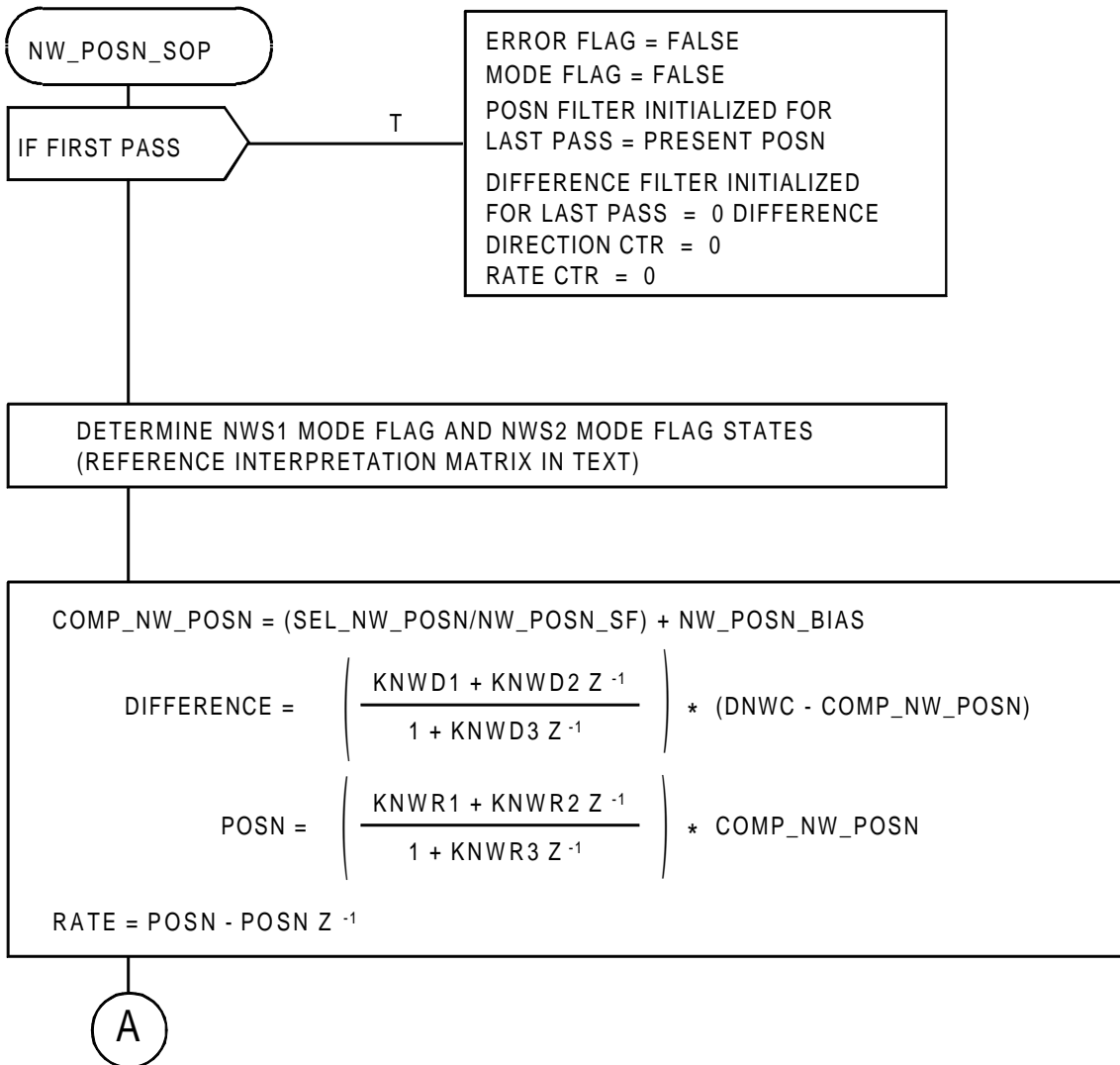


FIGURE 4.59-4.(1) Nose Wheel Position SOP Flow (Sheet 1 of 3)

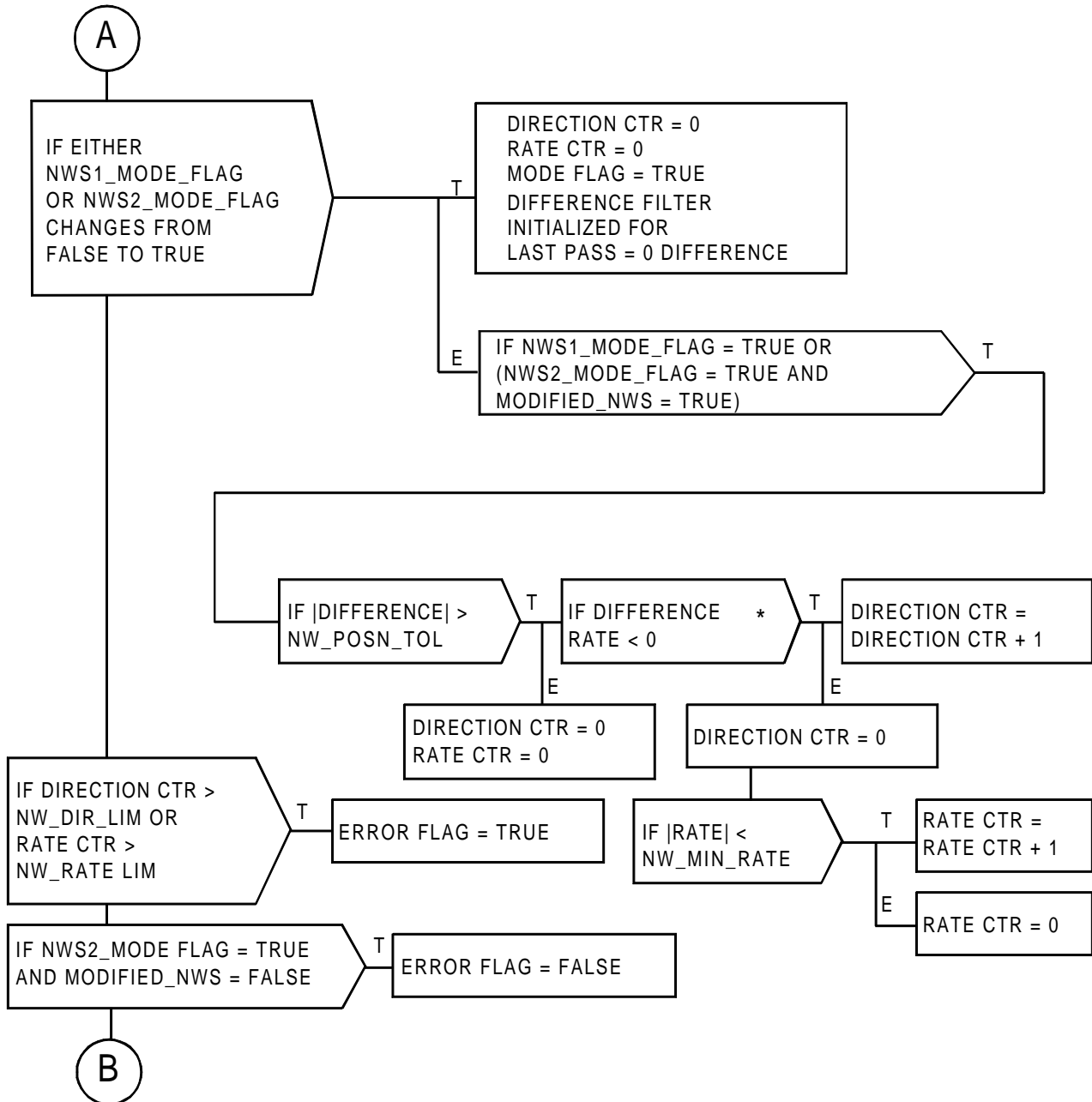


FIGURE 4.59-4.(2) Nose Wheel Position SOP Flow (Sheet 2 of 3)

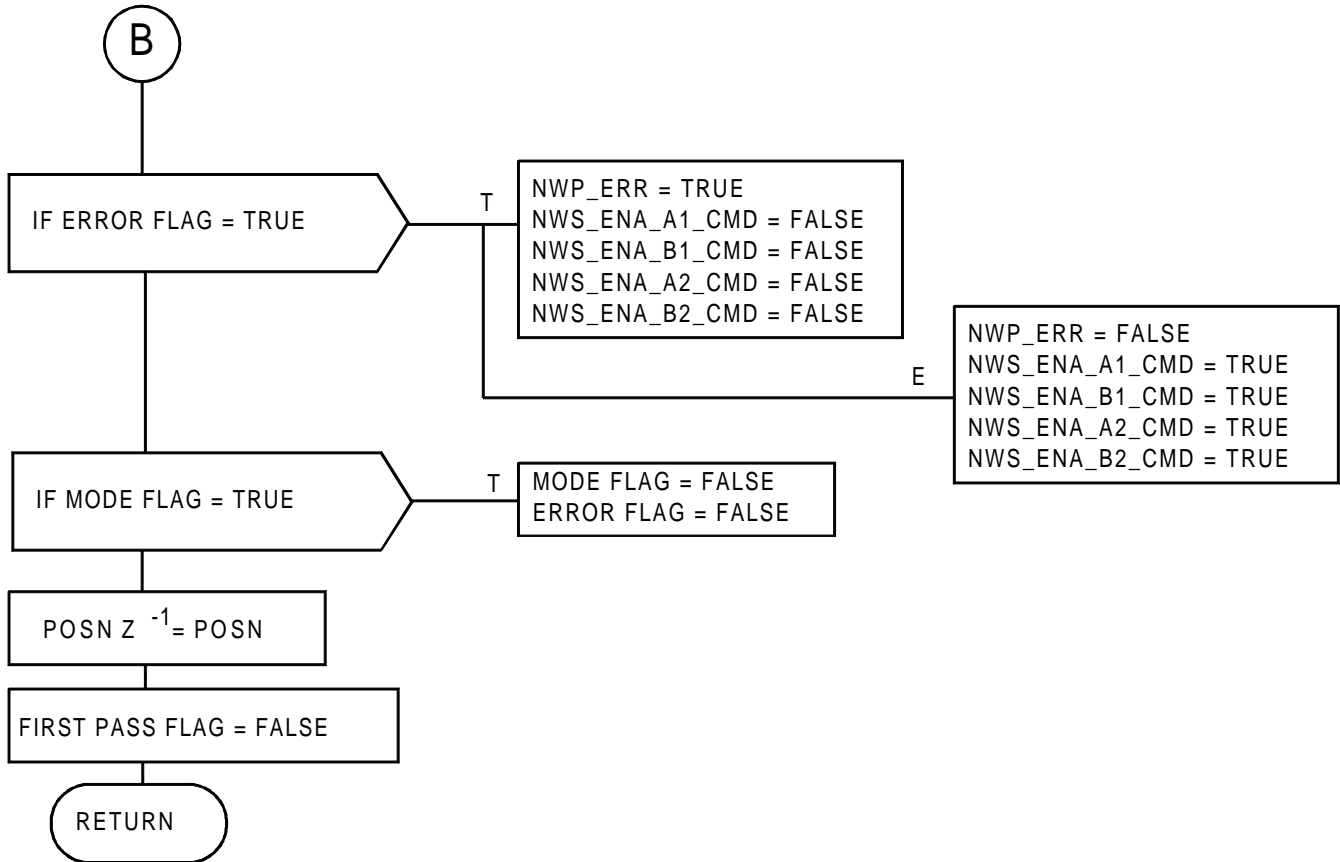


FIGURE 4.59-4.(3) Nose Wheel Position SOP Flow (Sheet 3 of 3)

This page intentionally left blank.

TABLE 4.59-5. INPUT FUNCTIONAL PARAMETERS FOR NOSE WHEEL POSITION SOP (G4.59)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-------------|------------|-----------------------------|-------------|-------|-----------|---------|------------|-------|
| DNWC | V90H1672CA | NOSEWHEEL DEFLECTION CMD | AEROJET DAP | DEG | | | 93017G | * |
| DNWC | V90H1672CB | NOSEWHEEL DEFLECTION CMD | GRTLS DAP | DEG | | | 89889H | |
| GSENL | V90X2554X | GROUND SPEED ENBL CMD - NWS | LANDING SOP | | BD | | 93017G | * |
| NWS1 | V72K1718XA | NOSE WHEEL STEERING 1 | D&C PNL | | EVENT | | 93017G | * |
| NWS1_CF | V91X6331XA | NOSE WHEEL STEERING 1 CF | FCOS | | BD | | 90182 | |
| NWS2 | V72K1719XA | NOSE WHEEL STEERING 2 | D&C PNL | | EVENT | | 93017G | * |
| NWS2_CF | V91X6333XA | NOSE WHEEL STEERING 2 CF | FCOS | | BD | | 90182 | |
| NW_ACT_1 | V51X0756X | NWS1 ACTIVE STATUS | SCB | | BD | | 93017G | * |
| NW_ACT_1_CF | V91X6332X | NWS1 ACTIVE STATUS CF | FCOS | | BD | | 89890E | |
| NW_ACT_2 | V51X0757X | NWS2 ACTIVE STATUS | SCB | | BD | | 93017G | * |
| NW_ACT_2_CF | V91X6334X | NWS2 ACTIVE STATUS CF | FCOS | | BD | | 89890E | |
| SEL_NW_POSN | V90H2550C | SELECT NOSE WHEEL POSITION | SF | | VDC | | HXS 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.59-6. OUTPUT FUNCTIONAL PARAMETERS FROM NOSE WHEEL POSITION SOP (G4.59)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|----------------|------------|--------------------------------|--------------------------|-------|-----------|------------------|---------|-------------|
| COMP_NW_POSN | V91H6378C | COMPENSATED NOSEWHEEL POSITION | AEROJET DAP GRTLS DAP | DEG | | | 89889H | |
| NWP_ERR | V72K1711X | NOSE WHEEL POSITION ERROR | DL FMT 23/1 LCA F3 | EVENT | BD | | 93017G | * |
| NWS1_MODE_FLAG | V91X6376X | NWS1 MODE | AEROJET DAP GRTLS DAP | | BD | | 89889H | |
| NWS2_MODE_FLAG | V91X6377X | NWS2 MODE | AEROJET DAP GRTLS DAP | | BD | | 89889H | |
| NWS_ENA_A1_CMD | V51K0758XA | NWS1 ENABLE A CMD | DL FMT 23/2 SCB | EVENT | BD | | 93017G | * |
| NWS_ENA_A2_CMD | V51K0760XA | NWS2 ENABLE A CMD | DL FMT 23/1 SCB | EVENT | BD | | 93017G | * |
| NWS_ENA_B1_CMD | V51K0759XA | NWS1 ENABLE B CMD | SCB | | BD | | 89889H | |
| NWS_ENA_B2_CMD | V51K0761XA | NWS2 ENABLE B CMD | SCB | | BD | | 89889H | |
| | V72M6624P | MDM FF01 DSCR OUT SET | CD 02 CH 0 DL FMT 23/2 | | | | 93017G | * |
| | V72M6724P | MDM FF03 DSCR OUT SET | CD 02 CH 0 DL FMT 23/1 | | | | 93017G | * |
| | V72M6774P | MDM FF04 DSCR OUT SET | CD 02 CH 0 DL FMT 23/1 | | | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.59-7. NOSE WHEEL POSITION SOP (G4.59) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|--------------|-----------|-----------|----|----|---|---|----------------|----|-----|---------|-------------|
| KNWD1 | V99U9707C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| KNWD2 | V99U9708C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| KNWD3 | V99U9709C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| KNWR1 | V99U9710C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| KNWR2 | V99U9711C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| KNWR3 | V99U9712C | ND | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| MODIFIED_NWS | V97U1471C | ND | D | | L | C | G4.50 G4.59 | 00 | ZF5 | 90014G | |
| NW_DIR_LIM | V99U9704C | COUNTS | I | S | D | C | G4.59 | 00 | NWS | 90102D | |
| NW_MIN_RATE | V99U9705C | DEG | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| NW_POSN_BIAS | V99U9702C | DEG | F | S | D | C | G4.59 V4.30 | 00 | NWS | 90102D | |
| NW_POSN_SF | V99U9701C | VDC/DEG | F | S | D | A | G4.59 V4.30 | 00 | NWS | 90102D | |
| NW_POSN_TOL | V99U9703C | DEG | F | S | D | C | G4.59 | 00 | NWS | 90102D | |
| NW_RATE_LIM | V99U9706C | COUNTS | I | S | D | C | G4.59 | 00 | NWS | 90102D | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.59-8. NOSE WHEEL POSITION SOP (G4.59) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.59-9. NOSE WHEEL POSITION SOP (G4.59) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

4.171 THREE-AXIS ROTATIONAL HAND CONTROLLER SOP

The purpose of the Three–Axis Rotational Hand Controller (3–AX RHC) SOP principal function shall be to perform the following functions:

- A. Compensation of the selected roll, pitch, and yaw transducer commands by application of scale factors and biases,
- B. Validation of the compensated RHC commands by the use of data good flags,
- C. Breakout deadbanding on the validated roll, pitch, and yaw commands,
- D. Detent processing with hysteresis on the validated RHC signals to generate detent integers,
- E. Performance of soft–stop checks with hysteresis on the validated RHC signals to generate soft–stop discrettes, and
- F. Processing of signals for both crew stations to produce resultant output commands (station select).

The 3–AX RHC SOP shall be processed on–demand in MM 102, 103 and 601 until ME_ZERO indicates the “1” state (main engines at zero thrust). The on–demand indication shall be whenever LCSS_PLAMP indicates the “1” state (FCS mode LH pitch to CSS) for the 3–AX RHC SOP to be performed; whenever LCSS_PLAMP indicates the “zero” state (FCS in auto), the 3–AX RHC SOP shall not be performed. Once ME_ZERO indicates the “1” state, the 3–AX RHC SOP shall be continuously scheduled in MM 103, 601, 104, 105, 106, 301, 302, and 303.

When the Ascent DAP transitions from MANUAL to AUTO, the detent/softstop hysteresis parameters (including past values) will be set to zero.

These functions shall be executed at the 12.5 Hz rate after GN&C SW RM and Selection Filter and prior to G/C Steer and TRANS DAP.

The 3–AX RHC SOP interfaces are provided on the functional block diagram of the 3–AX RHC SOP, Figure 4.171-1. Parameter initialization requirements are shown in Table 4.171-1. There is no requirement to process the left RHC data before or after the right RHC data. The IDD inputs and outputs are listed in Tables 4.171-2 and 4.171-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.171-4. K-loads are listed in Table 4.171-5. Constants are listed in Table 4.171-6.

| Table 4.171-1. Three-Axis RHC SOP Initialization Parameters | | | | | | | |
|---|-----------|--------------------------------|------------|-------------|---------------|---------------------|---------|
| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
| CRHCPC | V97U3431C | COMP SCALE FACTOR—LH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCPP | V97U3432C | COMP SCALE FACTOR—RH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRC | V97U3434C | COMP SCALE FACTOR—LH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRP | V97U3435C | COMP SCALE FACTOR—RH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCYC | V97U3437C | COMP SCALE FACTOR—LH RHC YAW | L | FLOAT PT | | +3.0547, +2.4993 | DEG/VDC |
| CRHCYP | V97U3438C | COMP SCALE FACTOR—RH RHC YAW | L | FLOAT PT | | +3.0547, +2.4993 | DEG/VDC |
| KRHCPC | V97U3595C | COMP BIAS—LH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCPP | V97U3596C | COMP BIAS—RH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRC | V97U3598C | COMP BIAS—LH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRP | V97U3599C | COMP BIAS—RH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCYC | V97U3601C | COMP BIAS—LH RHC YAW | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCYP | V97U3602C | COMP BIAS—RH RHC YAW | L | FLOAT PT | | +0.1, -0.1 | DEG |
| DB1 | V97U3450C | RHC ROLL BREAKOUT DEADBAND | R | FLOAT PT | 1.25 | +1.265, +1.035 | DEG |
| DB2 | V97U3451C | RHC PITCH BREAKOUT DEADBAND | R | FLOAT PT | 1.15 | +1.265, +1.035 | DEG |
| DB3 | V97U3459C | RHC YAW BREAKOUT DEADBAND | R | FLOAT PT | 0.65 | +0.715, +0.585 | DEG |
| DRHYS2 | V97U3455C | RHC ROLL DETENT 2 | D | FLOAT PT | | +3.795, +3.105 | DEG |
| DRHYS1 | V97U3454C | RHC ROLL DETENT 1 | D | FLOAT PT | | +0.6325, +0.5175 | DEG |
| DPHYS2 | V97U3453C | RHC PITCH DETENT 2 | D | FLOAT PT | | +3.795, +3.105 | DEG |
| DPHYS1 | V97U3452C | RHC PITCH DETENT 1 | D | FLOAT PT | | +0.6325, +0.5175 | DEG |
| DYHYS2 | V97U3458C | RH YAW DETENT 2 | D | FLOAT PT | | +2.145, +1.755 | DEG |

Table 4.171-1. Three-Axis RHC SOP Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------------|------------|-------------------------|------------|-------------|---------------|----------------|-------|
| DYHYS1 | V97U3457C | RHC YAW DETENT 1 | D | FLOAT PT | | +0.65 -0.35 | DEG |
| SSRHYS2 | | RHC ROLL SOFT STOP 2 | R | FLOAT PT | 21.176 | | DEG |
| SSRHYS1 | | RHC ROLL SOFT STOP 1 | R | FLOAT PT | 21.166 | | DEG |
| SSPHYS2 | | RHC PITCH SOFT STOP 2 | R | FLOAT PT | 21.171 | | DEG |
| SSPHYS1 | | RHC PITCH SOFT STOP 1 | R | FLOAT PT | 21.161 | | DEG |
| SSYHYS2 | | RHC YAW SOFT STOP 2 | R | FLOAT PT | 11.417 | | DEG |
| SSYHYS1 | | RHC YAW SOFT STOP 1 | R | FLOAT PT | 11.407 | | DEG |
| DAMAN | V96H0005CB | MANUAL ROLL COMMAND | | FLOAT PT | | | DEG |
| DEMAN | V96H0007CB | MANUAL PITCH COMMAND | | FLOAT PT | | | DEG |
| DYMAN | V96H0004CA | MANUAL YAW COMMAND | | FLOAT PT | | | DEG |
| RHC_STATE(1) | V96J0015CA | RHC OUT OF DETENT ROLL | | INTEGER | | | |
| RHC_STATE(2) | V96J0017CA | RHC OUT OF DETENT PITCH | | INTEGER | | | |
| RHC_STATE(3) | V96J0019CA | RHC OUT OF DETENT YAW | | INTEGER | | | |
| RSS_EXCEED | V96X1069XA | ROLL RHC SOFT-STOP | | DISCRETE | | | |
| PSS_EXCEED | V96X1070XA | PITCH RHC SOFT-STOP | | DISCRETE | | | |
| YSS_EXCEED | V96X1071XA | YAW RHC SOFT-STOP | | DISCRETE | | | |

4.171.1 RHC Compensation

The RHC compensation function shall consist of applying scale factors and biases to convert the selected RHC roll, pitch, and yaw commands into engineering units (degrees) in floating point format. Provisions shall be made for unique scale factor and bias values for each selected signal. The general compensation equation shall be as follows:

$$YC = YM C + K$$

where

YC = Compensated RHC signal (deg),

YM = Measured RHC signal (Vdc),

C = Compensation scale factor (deg/Vdc), and

K = Compensation bias (deg).

4.171.2 RHC Validation

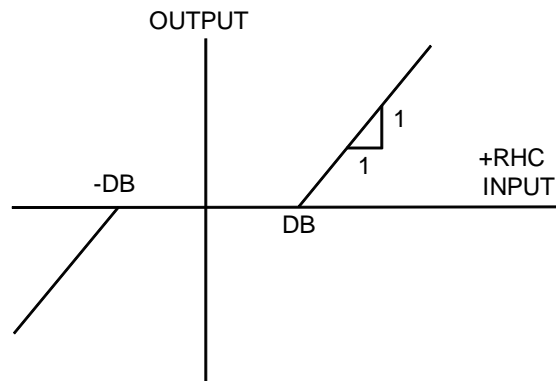
The RHC validation function shall monitor the RHC data good flags from Selection Filter to validate the compensated RHC signals. If any of the three data good flags for an RHC is FALSE, then the compensated roll, pitch, and yaw signals from the RHC shall be set to zero. If all three data good flags for an RHC are TRUE, then the compensated roll, pitch, and yaw signals from that RHC shall remain unaltered.

4.171.3 Scalar Commands

The RHC scalar commands shall be generated by deadbanding the valid signals and performing station selection.

A. RHC Deadbanding

This function shall apply breakout deadbands to the validated RHC roll, pitch, and yaw commands for each crew station. The deadband shall be DB degrees and is implemented as shown in the following diagram:



The OUTPUT is computed as follows:

For $|\text{INPUT}| < \text{DB}$, $\text{OUTPUT} = 0$;

For $|\text{INPUT}| \geq \text{DB}$, $\text{OUTPUT} = \text{INPUT} - \text{DB SIGN}(\text{INPUT})$

$$\text{where DB} = \begin{cases} \text{DB2 degrees for pitch,} \\ \text{DB1 degrees for roll,} \\ \text{DB3 degrees for yaw.} \end{cases}$$

B. RHC Station Select

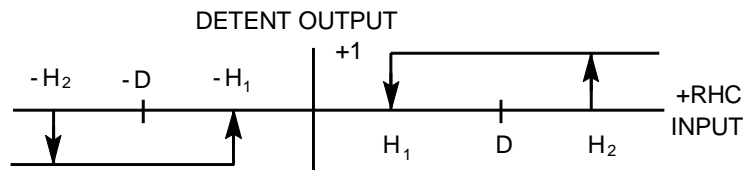
In each axis, the sum of the deadbanded scalar signals from the left and right RHCs shall be formed for output to user functions. This applies to each of the roll, pitch, and yaw axes.

4.171.4 Integer Commands

The RHC integer commands shall be generated by applying a detent check to the valid RHC signals and performing station selection.

A. RHC Detent Processing

This function shall apply a detent check to the valid RHC signals in all axes for both crew stations. The detents shall be D degrees. In addition, there shall be a hysteresis about the detents with widths of $(H_2 - H_1)$ degrees centered about the detents. The detent check with hysteresis shall be implemented as follows:



where $D = (H_1 + H_2) / 2$, and

$$(H_2 - H_1) = \begin{cases} \text{DPHYS2} - \text{DPHYS1} \text{ degrees for pitch,} \\ \text{DRHYS2} - \text{DRHYS1} \text{ degrees for roll,} \\ \text{DYHYS2} - \text{DYHYS1} \text{ degrees for yaw.} \end{cases}$$

The output shall be a signed integer with sense the same as the RHC deflection, and shall be generated as follows:

FOR $|\text{INPUT}| \leq H_1$, OUTPUT = 0;
 FOR $|\text{INPUT}| \geq H_2$, OUTPUT = 1 SIGN (INPUT); and
 FOR $H_1 < |\text{INPUT}| < H_2$ AND LAST OUTPUT \neq 1 SIGN (INPUT);
 OUTPUT = 0, otherwise, OUTPUT = LAST OUTPUT.

The detent outputs for each crew station shall be output to user functions.

B. Integer Station Select

In each of the roll, pitch, and yaw axes, the sum of the detent outputs from the left and right RHCs shall be formed and limited to 1 for output to the user functions.

C. RHC Downmode Crew Alert

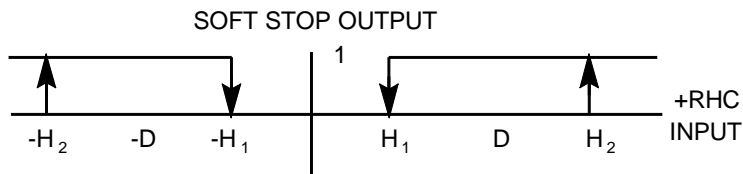
If the RHC is moved beyond the downmode threshold while the TRANS DAP is in AUTO mode (as indicated by the fwd DAP auto light) but not in Major Mode 601, a signal shall be sent to the GAX to annunciate a Class 3 warning to the crew.

4.171.5 Discrete Commands

The RHC discrete commands shall be generated by applying a soft stop check to the valid RHC signals and performing station selection.

A. RHC Soft Stop Checks

This function shall apply a soft stop check to the valid RHC signals in all axes for both crew stations. The soft stop shall be D degrees. In addition, there shall be a hysteresis about the soft stops with widths of (H₂–H₁) degrees centered about the soft stop. The soft stop check with hysteresis shall be implemented as follows:



where $D = (H_1 + H_2) / 2$, and

$$(H_2 - H_1) = \begin{cases} \text{SSPHYS1} - \text{SSPHYS1} \text{ degrees for pitch,} \\ \text{SSRHYS2} - \text{SSRHYS1} \text{ degrees for roll,} \\ \text{SSYHYS2} - \text{SSYHYS1} \text{ degrees for yaw.} \end{cases}$$

The output shall be a discrete and shall be generated as follows:

- For $|\text{INPUT}| \leq H_1$, $\text{OUTPUT} = 0$;
- For $|\text{INPUT}| \geq H_2$, $\text{OUTPUT} = 1$;
- For $H_1 < |\text{INPUT}| < H_2$ AND $\text{LAST OUTPUT} \neq 1 \text{ SIGN}(\text{INPUT})$;
 $\text{OUTPUT} = 0$; otherwise, $\text{OUTPUT} = \text{LAST OUTPUT}$.

B. Discrete Station Selection

In each of the roll, pitch and yaw axes, the logical OR of the soft stop discretelys from the left and right RHC shall be formed for output to user functions.

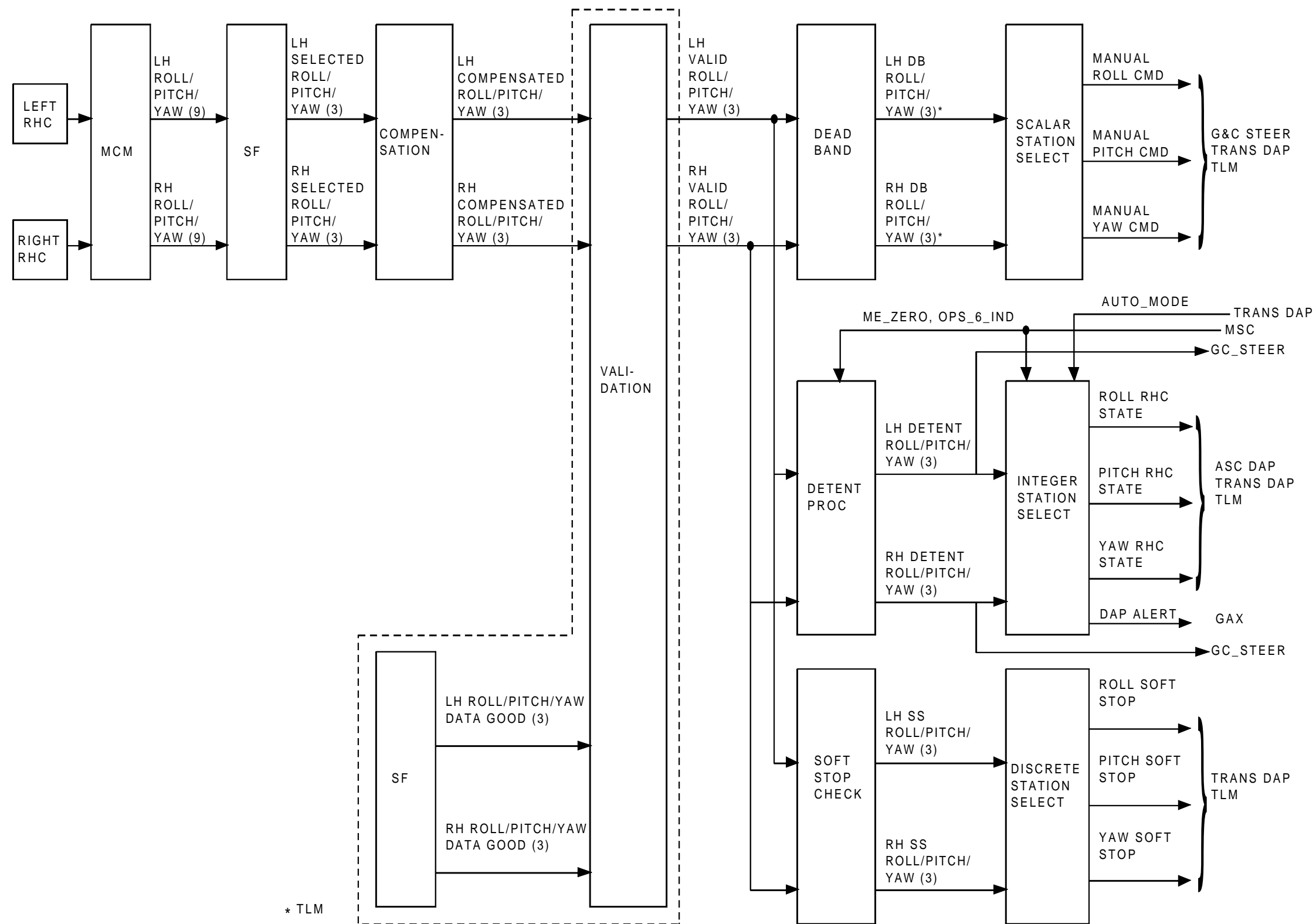


FIGURE 4.171-1. Three Axis RHC SOP Functional Block Diagram

This page intentionally left blank.

TABLE 4.171-2. INPUT FUNCTIONAL PARAMETERS FOR THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|--------------------|------------|------------------------------|-----------|-------|-----------|---------|---------|-------|
| AUTO | V90X1710X | AUTO GUIDANCE MODE FLAG | ASC DAP | | BD | | 93017G | * |
| AUTO_MODE | V72X2850XB | FWD DAP AUTO (LIGHT) | TRANS DAP | | | | 93017G | * |
| LCSS_PLAMP | V72X5241XB | FCS MODE-LH PITCH CSS | ASC DAP | | | | 93017G | * |
| L_PIT_DG | V90X6033X | LEFT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| ME_ZERO | V90X8638X | ZERO THRUST | MSC | | | | 92522D | |
| MM_CODE_601/MM_601 | V90X8194X | MAJOR MODE 601 FLAG | MSC | | BD | | 93012D | |
| R_PIT_DG | V90X6133X | RIGHT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| | V90H2519C | SELECTED RIGHT RHC YAW CMD | SF | VDC | SPL | | 93017G | * |
| | V90H2520C | SELECTED LEFT RHC YAW CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6001C | SELECTED LEFT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6031C | SELECTED LEFT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6101C | SELECTED RIGHT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6131C | SELECTED RIGHT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90X2521X | LEFT RHC YAW DATA GOOD | SF | | BD | | 93017G | * |
| | V90X2522X | RIGHT RHC YAW DATA GOOD | SF | | BD | | 93017G | * |
| | V90X6003X | LEFT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |
| | V90X6103X | RIGHT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.171-3. OUTPUT FUNCTIONAL PARAMETERS FROM THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-------------------------|------------|-----------------------------------|-------------|-------|--------------|------------------|---------|-------------|
| DACDB | V96H1025CB | LH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DAMAN/RHC(1) | V96H0005CB | MANUAL ROLL CMD | G/C STEER | DEG | | | | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| DAPDB | V96H1024CB | RH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DAP_ALERT | V96X0041XB | RHC DAP DNMODE | GAX | | BD | | 90704F | |
| DECDB | V96H1027CB | LH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DEMAN/RHC(2) | V96H0007CB | MANUAL PITCH CMD | G/C STEER | DEG | | | | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| DEPDB | V96H1026CB | RH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DYMAN/RHC(3) | V96H0004CA | MANUAL YAW COMMAND | G/C STEER | DEG | | | | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| PSS_EXCEED/SOFT_STOP(2) | V96X1070XA | PITCH RHC SOFT-STOP FLAG | TLM | | | | 89558A | |
| | | | TRANS DAP | | | | | |
| RHC_STATE(1) | V96J0015CA | RHC OUT OF DETENT ROLL | ASC DAP | | | | 89990E | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| RHC_STATE(2) | V96J0017CA | RHC OUT OF DETENT PITCH | ASC DAP | | | | 89990E | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| RHC_STATE(3) | V96J0019CA | RHC OUT OF DETENT YAW | ASC DAP | | | | 89990E | |
| | | | TLM | | | | | |
| | | | TRANS DAP | | | | | |
| RHC_STATE_C(1) | V96U0995C | COMMANDER RHC OUT OF DETENT ROLL | G/C STEER | | | | | |
| RHC_STATE_C(2) | V96U0996C | COMMANDER RHC OUT OF DETENT PITCH | G/C STEER | | | | | |
| RHC_STATE_C(3) | V96U0997C | COMMANDER RHC OUT OF DETENT YAW | G/C STEER | | | | | |
| RHC_STATE_P(1) | V96U0998C | PILOT RHC OUT OF DETENT ROLL | G/C STEER | | | | | |
| RHC_STATE_P(2) | V96U0999C | PILOT RHC OUT OF DETENT PITCH | G/C STEER | | | | | |
| RHC_STATE_P(3) | V96U1000C | PILOT RHC OUT OF DETENT YAW | G/C STEER | | | | | |
| RSS_EXCEED/SOFT_STOP(1) | V96X1069XA | ROLL RHC SOFT-STOP FLAG | TLM | | | | 89558A | |
| | | | TRANS DAP | | | | | |
| YSS_EXCEED/SOFT_STOP(3) | V96X1071XA | YAW RHC SOFT-STOP FLAG | TLM | | | | 89558A | |
| | | | TRANS DAP | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec

TABLE 4.171-4. THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------------------------|----------------------|--------------------------|---------|-------------|
| CRHCPC | V97U3431C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCPP | V97U3432C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRC | V97U3434C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRP | V97U3435C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCYC | V97U3437C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCYP | V97U3438C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| DB1 | V97U3450C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB2 | V97U3451C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB3 | V97U3459C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DPHYS1 | V97U3452C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DPHYS2 | V97U3453C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| DRHYS1 | V97U3454C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DRHYS2 | V97U3455C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| DYHYS1 | V97U3457C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DYHYS2 | V97U3458C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| KRHPCP | V97U3595C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |

TABLE 4.171-4. THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------------------------|----|-----|---------|-------------|
| KRHCPP | V97U3596C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRC | V97U3598C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRP | V97U3599C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCYC | V97U3601C | DEG | F | S | L | C | G4.171 G4.199 | 00 | ZSO | DC0813 | |
| KRHCYP | V97U3602C | DEG | F | S | L | C | G4.171 G4.199 | 00 | ZSO | DC0813 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.171-5. THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.171-6. THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.171) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|----------------------------------|-----------|----|----------------|-----------|----|--------|---|------------------|---------|-------------|
| SSPHYS1 RHC PITCH SOFT STOP 1 | V97U6227C | 00 | +2.1161 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSPHYS2 RHC PITCH SOFT STOP 2 | V97U6228C | 00 | +2.1171 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSRHYS1 RHC ROLL SOFT STOP 1 | V97U6229C | 00 | +2.1166 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSRHYS2 RHC ROLL SOFT STOP 2 | V97U6230C | 00 | +2.1176 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSYHYS1 RHC YAW SOFT STOP 1 | V97U6231C | 00 | +1.1407 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSYHYS2 RHC YAW SOFT STOP 2 | V97U6232C | 00 | +1.1417 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.199 ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP

The purpose of the Orbital Three–Axis Rotational Hand Controller (ORB 3–AX RHC) SOP principal function shall be to perform the following functions:

- A. Compensation of the selected left, right, and aft RHC commands by application of scale factors and biases;
- B. Validation of the compensated RHC commands by use of data good flags;
- C. Processing of breakout deadbanding on the validated RHC signals to produce deadbanded scalar commands;
- D. Processing of detent with hysteresis on the validated RHC signals to generate detent commands;
- E. Processing of soft–stop checks with hysteresis on the validated RHC signals to generate soft–stop discretetes;
- F. Transformation of all aft station RHC signals as a function of the sense switch prior to any station selection; and
- G. Processing of signals for all three crew stations to generate resultant output commands (station select).

The ORB 3–AX RHC SOP functions shall be processing for all three crew stations at the 12.5 Hz rate. These functions shall be executed in the order stated above after Selection Filter (SF) and GN&C SW RM and prior to ON–ORBIT DAP.

The ORB 3–AX RHC SOP interfaces are indicated by the functional block diagram on Figure 4.199–1. The parameter initialization requirements are shown in Table 4.199–1. The IDD inputs and outputs are listed in Tables 4.199–2 and 4.199–3. Values for the I–loads are contained in the I–load requirements document (JSC–19350); however, I–load definitions applicable to this principal function are listed in Table 4.199–4. K–loads are listed in Table 4.199–5. Constants are listed in Table 4.199–6.

Table 4.199-1. Orbital Three-Axis RHC Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------|-----------|---------------------------------|------------|-------------|---------------|------------------|---------|
| CRHCPC | V97U3431C | COMP SCALE FACTOR—LH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCPP | V97U3432C | COMP SCALE FACTOR—RH RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCPA | V97U3430C | COMP SCALE FACTOR—AFT RHC PITCH | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRC | V97U3434C | COMP SCALE FACTOR—LH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRP | V97U3435C | COMP SCALE FACTOR—RH RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCRA | V97U3433C | COMP SCALE FACTOR—AFT RHC ROLL | L | FLOAT PT | | +5.2381, +4.2857 | DEG/VDC |
| CRHCYC | V97U3437C | COMP SCALE FACTOR—LH RHC YAW | L | FLOAT PT | | +3.0547, +2.4993 | DEG/VDC |
| CRHCYP | V97U3438C | COMP SCALE FACTOR—RH RHC YAW | L | FLOAT PT | | +3.0547, +2.4993 | DEG/VDC |
| CRHCYA | V97U3436C | COMP SCALE FACTOR—AFT RHC YAW | L | FLOAT PT | | +3.0547, +2.4993 | DEG/VDC |
| KRHCPC | V97U3595C | COMP BIAS—LH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCPP | V97U3596C | COMP BIAS—RH RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCPA | V97U3594C | COMP BIAS—AFT RHC PITCH | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRC | V97U3598C | COMP BIAS—LH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRP | V97U3599C | COMP BIAS—RH RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCRA | V97U3597C | COMP BIAS—AFT RHC ROLL | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCYC | V97U3601C | COMP BIAS—LH RHC YAW | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCYP | V97U3602C | COMP BIAS—RH RHC YAW | L | FLOAT PT | | +0.1, -0.1 | DEG |
| KRHCYA | V97U3600C | COMP BIAS—AFT RHC YAW | L | FLOAT PT | | +0.1, -0.1 | DEG |
| DB1 | V97U3450C | RHC ROLL BREAKOUT DEADBAND | D | FLOAT PT | | +1.265, +1.035 | DEG |
| DB2 | V97U3451C | RHC PITCH BREAKOUT DEADBAND | D | FLOAT PT | | +1.265, +1.035 | DEG |
| DB3 | V97U3459C | RHC YAW BREAKOUT DEADBAND | D | FLOAT PT | | +0.715, -0.585 | DEG |

Table 4.199-1. Orbital Three-Axis RHC Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------------|------------|---------------------------------|------------|-------------|---------------|---------------------|-------|
| DRHYS2 | V97U3455C | RHC ROLL DETENT 2 | D | FLOAT PT | | +4.719, +3.861 | DEG |
| DRHYS1 | V97U3454C | RHC ROLL DETENT 1 | D | FLOAT PT | | +0.6325, +0.5175 | DEG |
| DPHYS2 | V97U3453C | RHC PITCH DETENT 2 | D | FLOAT PT | | +4.719, +3.861 | DEG |
| DPHYS1 | V97U3452C | RHC PITCH DETENT 1 | D | FLOAT PT | | +0.6325, +0.5175 | DEG |
| DYHYS2 | V97U3458C | RHC YAW DETENT 2 | D | FLOAT PT | | +2.739, +2.291 | DEG |
| DYHYS1 | V97U3457C | RHC YAW DETENT 1 | D | FLOAT PT | | +0.65, +0.35 | DEG |
| SSRHYS2 | | RHC ROLL SOFT STOP 2 | R | FLOAT PT | 21.176 | | DEG |
| SSRHYS1 | | RHC ROLL SOFT STOP 1 | R | FLOAT PT | 21.166 | | DEG |
| SSPHYS2 | | RHC PITCH SOFT STOP 2 | R | FLOAT PT | 21.171 | | DEG |
| SSPHYS1 | | RHC PITCH SOFT STOP 1 | R | FLOAT PT | 21.161 | | DEG |
| SSYHYS2 | | RHC YAW SOFT STOP 2 | R | FLOAT PT | 11.417 | | DEG |
| SSYHYS1 | | RHC YAW SOFT STOP 1 | R | FLOAT PT | 11.407 | | DEG |
| TRANS_ROLL | V98U7962C | AFT ROLL TRANSFORM SCALE FACTOR | D | FLOAT PT | | | N.D. |
| TRANS_YAW | V98U7963C | AFT YAW TRANSFORM SCALE FACTOR | D | FLOAT PT | | | N.D. |
| DAMAN | V96H0005CC | MANUAL ROLL CMD | | FLOAT PT | 0.0 | | DEG |
| DEMAN | V96H0007CC | MANUAL PITCH CMD | | FLOAT PT | 0.0 | | DEG |
| DYMAN | V96H0004CB | MANUAL YAW CMD | | FLOAT PT | 0.0 | | DEG |
| RHC_STATE(1) | V96J0015CC | RHC OUT OF DETENT ROLL | | INTEGER | 0 | | |
| RHC_STATE(2) | V96J0017CC | RHC OUT OF DETENT PITCH | | INTEGER | 0 | | |
| RHC_STATE(3) | V96J0019CB | RHC OUT OF DETENT YAW | | INTEGER | 0 | | |
| PSS_EXCEED | V96X1070XC | PITCH RHC SOFT-STOP | | DISCRETE | 0 | | |
| RSS_EXCEED | V96X1069XB | ROLL RHC SOFT-STOP | | DISCRETE | 0 | | |
| YSS_EXCEED | V96X1071XB | YAW RHC SOFT-STOP | | DISCRETE | 0 | | |

4.199.1 RHC Compensation

The RHC compensation function shall consist of applying scale factors and biases to convert the selected left, right, and aft RHC commands into engineering units (degrees) in floating point format. Provisions shall be made for unique scale factors and biases for each selected signal. The general compensation equation shall be as follows:

$$YC = YM C + K,$$

where

- YC = Compensated signal (deg),
- YM = Measured signal (Vdc),
- C = Compensation scale factor (deg/Vdc), and
- K = Compensation bias (deg).

4.199.2 RHC Validation

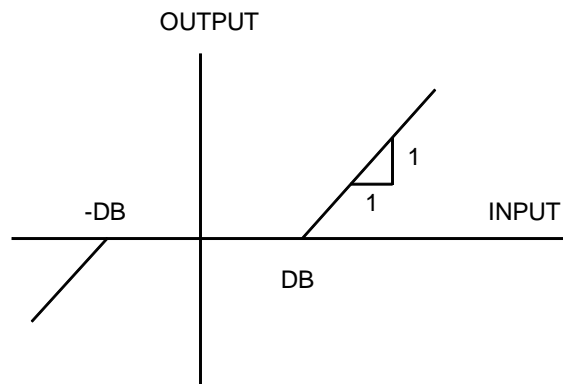
The RHC validation function shall monitor the RHC data good flags from SF to validate the compensated RHC signals. If any of the three data good flags for an RHC is FALSE, then the compensated roll, pitch, and yaw signals from that RHC shall be set to zero. If all three data good flags for an RHC are TRUE, then the compensated roll, pitch, and yaw signals from that RHC shall remain unaltered.

4.199.3 Scalar Commands

The RHC scalar commands shall be generated by deadbanding the valid signals, transforming the aft signals, and performing station selections.

A. RHC Deadbanding

The RHC deadbanding function shall apply breakout deadbands to the validated RHC roll, pitch, and yaw commands for each crew station. The deadband shall be DB degrees and is implemented as shown in the following diagram:



The OUTPUT is computed as follows:

For $|\text{INPUT}| < \text{DB}$, $\text{OUTPUT} = 0$;

For $|\text{INPUT}| \geq \text{DB}$, $\text{OUTPUT} = \text{INPUT} - \text{DB} \text{ SIGN}(\text{INPUT})$;

$$\text{where DB} = \begin{cases} \text{DB2 degrees for pitch,} \\ \text{DB1 degrees for roll,} \\ \text{DB3 degrees for yaw.} \end{cases}$$

B. Aft RHC Transformation

The transformation function shall consist of monitoring the $-X/-Z$ sense discrete from the GN&C SW RM and transforming the aft RHC signals.

When the $-X/-Z$ sense discrete indicates a “1” state ($-X$ sense), then the aft RHC signals shall be transformed 180 degrees in yaw. When the sense discrete indicates a “zero” state ($-Z$ sense), then the aft RHC signals shall be transformed 180 degrees in yaw and $+90$ in pitch. These transformations shall result in the following:

| Aft RHC Inputs | Transformed Aft RHC Outputs | |
|----------------|-----------------------------|------------|
| | $-X$ Sense | $-Z$ Sense |
| +Roll | -Roll | -Yaw |
| -Roll | +Roll | +Yaw |
| +Pitch | -Pitch | -Pitch |
| -Pitch | +Pitch | +Pitch |
| +Yaw | +Yaw | -Roll |
| -Yaw | -Yaw | +Roll |

When in the $-Z$ sense, an additional scale factor shall be applied to the aft roll and yaw compensated signals as follows:

$$\text{DAAC} = (\text{DAAC}) (\text{TRANS_ROLL}), \text{ and}$$

$$\text{DYAC} = (\text{DYAC}) (\text{TRANS_YAW}),$$

where

DAAC = Compensated AFT RHC roll (deg),

DYAC = Compensated AFT RHC yaw (deg),

TRANS_ROLL = AFT roll transformation scale factor (n.d.), and

TRANS_YAW = AFT yaw transformation scale factor (n.d.).

C. RHC Station Select

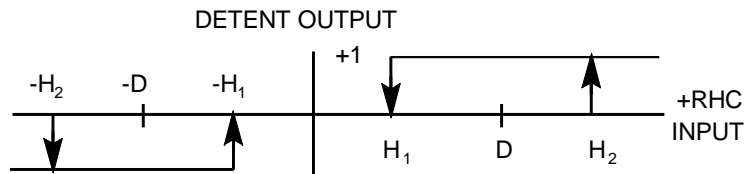
The deadbanded signals from the left and right RHCs and the transformed signal from the aft RHC shall be summed by axis to generate the manual RHC output commands. These commands shall be provided to user functions.

4.199.4 Integer Commands

The RHC integer commands shall be generated by detent checking the valid signals, transforming the aft signals, and performing station selection.

A. RHC Detent Processing

The RHC detent processing shall apply a detent check to the valid RHC signals in all axes for each crew station. The detents shall be D degrees. In addition, there shall be a hysteresis about the detents with widths of $(H_2 - H_1)$ degrees centered about the detents. The detent check with hysteresis shall be implemented as follows:



where $D = (H_1 + H_2) / 2$, and

$$(H_2 - H_1) = \begin{cases} \text{DPHYS2} - \text{DPHYS1} \text{ degrees for pitch,} \\ \text{DRHYS2} - \text{DRHYS1} \text{ degrees for roll,} \\ \text{DYHYS2} - \text{DYHYS1} \text{ degrees for yaw.} \end{cases}$$

The output shall be a signed integer with sense the same as the RHC deflection, and shall be generated as follows:

- FOR $|\text{INPUT}| \leq H_1$, $\text{OUTPUT} = 0$;
- FOR $|\text{INPUT}| \geq H_2$, $\text{OUTPUT} = \text{sign}(\text{INPUT})$; and
- FOR $H_1 < |\text{INPUT}| < H_2$ and if $\text{LAST OUTPUT} \neq \text{SIGN}(\text{INPUT})$;
- then $\text{OUTPUT} = 0$; otherwise, $\text{OUTPUT} = \text{LAST OUTPUT}$.

B. Aft RHC Transformation

The transformation function shall consist of monitoring the $-X/-Z$ sense discrete from the GN&C SW RM and transforming the aft RHC signals.

When the $-X/-Z$ sense discrete indicates a “1” state ($-X$ sense), then the aft RHC signals shall be transformed 180 degrees in yaw. When the sense discrete indicates a “zero” state ($-Z$ sense), then the aft RHC signals shall be transformed 180 degrees in yaw and $+90$ in pitch. These transformations shall result in the following:

| Aft RHC Inputs | Transformed Aft RHC Outputs | |
|----------------|-----------------------------|------------|
| | $-X$ Sense | $-Z$ Sense |
| +Roll | -Roll | -Yaw |
| -Roll | +Roll | +Yaw |
| +Pitch | -Pitch | -Pitch |
| -Pitch | +Pitch | +Pitch |
| +Yaw | +Yaw | -Roll |
| -Yaw | -Yaw | +Roll |

C. RHC Integer Station Select

The detent integers from the left and right RHCs and the transformed integer from the aft RHC shall be summed by axis and then limited to ± 1 for output to user functions.

D. RHC Downmode Crew Alert

If the RHC is moved beyond the downmode threshold while the ORBIT DAP is in AUTO mode (as indicated by the fwd DAP auto light) a signal shall be sent to the GAX to annunciate a Class 3 warning to the crew.

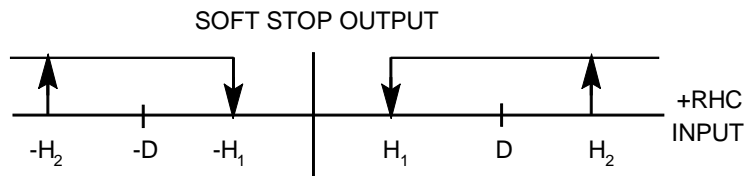
Note that a DAP downmode message will go unannounced under the following conditions: if a DAP downmode due to a RHC deflection occurs after the final execution of GAX and prior to an OPS transition or if after a transition to OPS 2, the RHC is out of detent during the first execution of the ORB 3-AX RHC SOP.

4.199.5 Discrete Commands

The RHC discrete command processing shall generate RHC discrete commands by soft stop checking the valid signals, transforming the aft signals, and performing station selection.

A. RHC Soft Stop Checks

The RHC soft stop function shall apply a soft stop check to the valid RHC signals in all axes for each crew station. The soft stop shall be D degrees. In addition, there shall be a hysteresis about the soft stop with widths of (H_2-H_1) degrees centered about the soft stops. The soft stop check with hysteresis shall be implemented as follows:



where $D = (H_1 + H_2) / 2$, and

$$(H_2 - H_1) = \begin{cases} \text{SSPHYS2} - \text{SSPHYS1} \text{ degrees for pitch,} \\ \text{SSRHYS2} - \text{SSRHYS1} \text{ degrees for roll,} \\ \text{SSYHYS2} - \text{SSYHYS1} \text{ degrees for yaw.} \end{cases}$$

The output shall be a discrete and shall be generated as follows:

- For $|\text{INPUT}| \leq H_1$, $\text{OUTPUT} = 0$;
- For $|\text{INPUT}| \geq H_2$, $\text{OUTPUT} = 1$;
- For $H_1 < |\text{INPUT}| < H_2$, $\text{OUTPUT} = \text{LAST OUTPUT}$.

Note that if $|\text{INPUT}| > H_1$ and $\text{OUTPUT} = 1$ on one pass through ORB 3-AX RHC SOP and $H_1 \leq |\text{INPUT}| < H_2$ on the next pass, regardless of the sign of INPUT , then OUTPUT remains “1”. This means that if the RHC is out of soft stop in one direction (RCS jets firing) and then jumps to the interior of the opposite soft stop interval, the previously firing jets will cut off and the opposing jets will begin firing.

B. Aft RHC Transformation

The transformation function shall consist of monitoring the -X/-Z sense discrete from the GN&C SW RM and transforming the aft RHC signals.

When the -X/-Z sense discrete indicates a “1” state (-X sense), then the aft RHC signals shall be transformed 180 degrees in yaw. When the sense discrete indicates a “zero” state (-Z sense), then the aft RHC signals shall be transformed 180 degrees in yaw and +90 in pitch. These transformations shall result in the following:

| Aft RHC Inputs | Transformed Aft RHC Outputs | |
|----------------|-----------------------------|----------|
| | -X Sense | -Z Sense |
| +Roll | -Roll | -Yaw |
| -Roll | +Roll | +Yaw |
| +Pitch | -Pitch | -Pitch |
| -Pitch | +Pitch | +Pitch |
| +Yaw | +Yaw | -Roll |
| -Yaw | -Yaw | +Roll |

C. RHC Soft Stop Station Select

The soft stop discrettes from the left and right RHCs and the transformed discrete from the aft RHC shall be logical “OR’d” together by axis to generate soft stop discrettes for use by the user functions.

This page intentionally left blank.

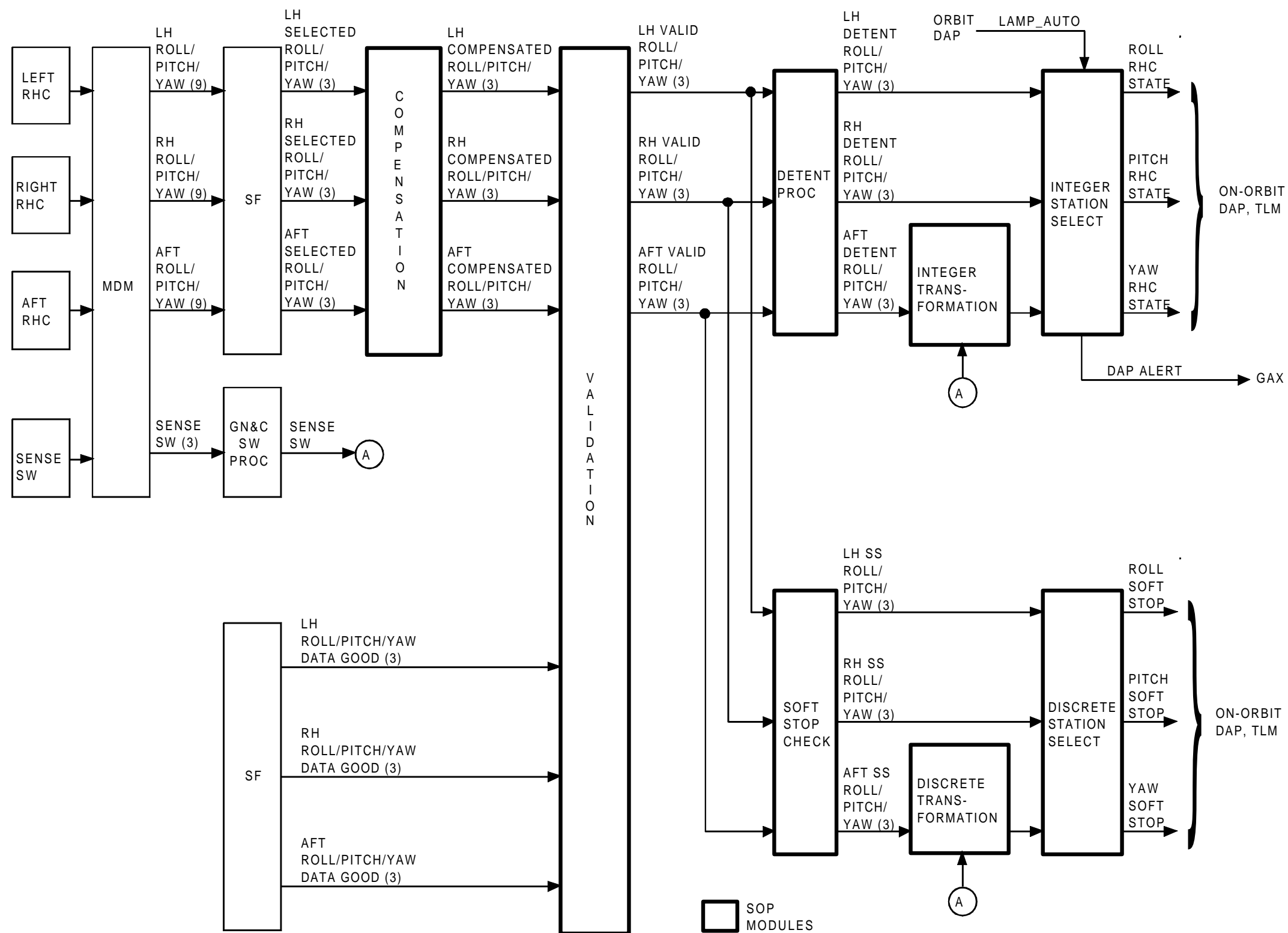


FIGURE 4.199-1. Orbital Three-Axis RHC SOP Functional Block Diagram

This page intentionally left blank.

TABLE 4.199-2. INPUT FUNCTIONAL PARAMETERS FOR ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP
(G4.199)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|------------|------------------------------|------------|-------|-----------|---------|---------|-------|
| LAMP_AUTO | V72X2850XA | FWD DAP AUTO (LIGHT) | ORB DAP | | | | 93017G | * |
| L_PIT_DG | V90X6033X | LEFT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| R_PIT_DG | V90X6133X | RIGHT RHC PITCH DATA GOOD | SF | | BD | | 93017G | * |
| SENSE_SW | V90X7700X | SEL SENSE -X | GN&C SW RM | | BD | | 93017G | * |
| | V90H2519C | SELECTED RIGHT RHC YAW CMD | SF | VDC | SPL | | 93017G | * |
| | V90H2520C | SELECTED LEFT RHC YAW CMD | SF | VDC | SPL | | 93017G | * |
| | V90H2538C | SELECTED AFT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90H2542C | SELECTED AFT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H2545C | SELECTED AFT RHC YAW CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6001C | SELECTED LEFT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6031C | SELECTED LEFT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6101C | SELECTED RIGHT RHC ROLL CMD | SF | VDC | SPL | | 93017G | * |
| | V90H6131C | SELECTED RIGHT RHC PITCH CMD | SF | VDC | SPL | | 93017G | * |
| | V90X2521X | LEFT RHC YAW DATA GOOD | SF | | BD | | 93017G | * |
| | V90X2522X | RIGHT RHC YAW DATA GOOD | SF | | BD | | 93017G | * |
| | V90X2539X | AFT RHC ROLL DATA GOOD | SF | | | | | |
| | V90X2543X | AFT RHC PITCH DATA GOOD | SF | | | | | |
| | V90X2544X | AFT RHC YAW DATA GOOD | SF | | | | | |
| | V90X6003X | LEFT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |
| | V90X6103X | RIGHT RHC ROLL DATA GOOD | SF | | BD | | 93017G | * |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.199-3. OUTPUT FUNCTIONAL PARAMETERS FROM ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP
(G4.199)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-------------------------|------------|-----------------------------|-------------|-------|--------------|------------------|---------|-------------|
| DACDB | V96H1027CC | LH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DAMAN/RHC(1) | V96H0005CC | MANUAL ROLL CMD | ORB DAP | DEG | | | | |
| | | | TLM | | | | | |
| DAPDB | V96H1026CC | RH DEADBANDED RHC PITCH CMD | TLM | DEG | | | | |
| DAP_ALERT | V96X0041XC | RHC DAP DNMODE | GAX | | BD | | 90704F | |
| DECDB | V96H1025CC | LH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DEFDB | V96H1024CC | RH DEADBANDED RHC ROLL CMD | TLM | DEG | | | | |
| DEMAN/RHC(2) | V96H0007CC | MANUAL PITCH CMD | ORB DAP | DEG | | | | |
| | | | TLM | | | | | |
| DYMAN/RHC(3) | V96H0004CB | MANUAL YAW COMMAND | ORB DAP | DEG | | | | |
| | | | TLM | | | | | |
| PSS_EXCEED/SOFT_STOP(2) | V96X1070XC | PITCH RHC SOFT-STOP FLAG | ORB DAP | | | | 89752A | |
| | | | TLM | | | | | |
| RHC_STATE(1) | V96J0015CC | RHC OUT OF DETENT ROLL | ORB DAP | | | | | |
| | | | TLM | | | | | |
| RHC_STATE(2) | V96J0017CC | RHC OUT OF DETENT PITCH | ORB DAP | | | | | |
| | | | TLM | | | | | |
| RHC_STATE(3) | V96J0019CB | RHC OUT OF DETENT YAW | ORB DAP | | | | 89688A | |
| | | | TLM | | | | | |
| RSS_EXCEED/SOFT_STOP(1) | V96X1069XB | ROLL RHC SOFT-STOP FLAG | ORB DAP | | | | 89752A | |
| | | | TLM | | | | | |
| YSS_EXCEED/SOFT_STOP(3) | V96X1071XB | YAW RHC SOFT-STOP FLAG | ORB DAP | | | | 89752A | |
| | | | TLM | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

**Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
(HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec**

TABLE 4.199-4. ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|-----------|-----------|----|----|---|---|---------------------------|----------------------|--------------------------|---------|-------------|
| CRHCPA | V97U3430C | DEG/VDC | F | S | D | P | G4.199 | 00 | ZFO | DC0599 | |
| CRHCPC | V97U3431C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCPP | V97U3432C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRA | V97U3433C | DEG/VDC | F | S | D | P | G4.199 | 00 | ZFO | DC0599 | |
| CRHCRC | V97U3434C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCRP | V97U3435C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCYA | V97U3436C | DEG/VDC | F | S | D | P | G4.199 | 00 | ZFO | DC0599 | |
| CRHCYC | V97U3437C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| CRHCYP | V97U3438C | DEG/VDC | F | S | D | A | G4.171 G4.199 G4.53 | 00 | ZFO | DC0599 | |
| DB1 | V97U3450C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB2 | V97U3451C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DB3 | V97U3459C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DPHYS1 | V97U3452C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DPHYS2 | V97U3453C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| DRHYS1 | V97U3454C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DRHYS2 | V97U3455C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| DYHYS1 | V97U3457C | DEG | F | S | D | X | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| DYHYS2 | V97U3458C | DEG | F | S | D | X | G4.171 G4.199 | 01 02 03 08 | ZFO ZFO ZFO ZFO | DC0599 | |
| KRHCPA | V97U3594C | DEG | F | S | L | P | G4.199 | 00 | ZSO | DC0813 | |

TABLE 4.199-4. ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|------------|-----------|-----------|----|----|---|---|---------------------------|----|-----|---------|-------------|
| KRHCPC | V97U3595C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCPP | V97U3596C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRA | V97U3597C | DEG | F | S | L | P | G4.199 | 00 | ZSO | DC0813 | |
| KRHCRC | V97U3598C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCRP | V97U3599C | DEG | F | S | L | C | G4.171 G4.199 G4.53 | 00 | ZSO | DC0813 | |
| KRHCYA | V97U3600C | DEG | F | S | L | P | G4.199 | 00 | ZSO | DC0813 | |
| KRHCYC | V97U3601C | DEG | F | S | L | C | G4.171 G4.199 | 00 | ZSO | DC0813 | |
| KRHCYP | V97U3602C | DEG | F | S | L | C | G4.171 G4.199 | 00 | ZSO | DC0813 | |
| TRANS_ROLL | V98U7962C | ND | F | S | D | P | G4.199 | 00 | ZSO | DC0813 | |
| TRANS_YAW | V98U7963C | ND | F | S | D | P | G4.199 | 00 | ZSO | DC0813 | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.199-5. ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.199-6. ORBITAL THREE-AXIS ROTATIONAL HAND CONTROLLER SOP (G4.199) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|----------------------------------|-----------|----|----------------|-----------|----|--------|---|------------------|---------|-------------|
| SSPHYS1 RHC PITCH SOFT STOP 1 | V97U6227C | 00 | +2.1161 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSPHYS2 RHC PITCH SOFT STOP 2 | V97U6228C | 00 | +2.1171 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSRHYS1 RHC ROLL SOFT STOP 1 | V97U6229C | 00 | +2.1166 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSRHYS2 RHC ROLL SOFT STOP 2 | V97U6230C | 00 | +2.1176 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSYHYS1 RHC YAW SOFT STOP 1 | V97U6231C | 00 | +1.1407 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |
| SSYHYS2 RHC YAW SOFT STOP 2 | V97U6232C | 00 | +1.1417 | E+01 DEG | F | S | P | G4.171 G4.199 | 90374C | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

4.216 FLIGHT CONTROL SWITCH SOP

The purpose of the Flight Control Switch (FC SWIT) SOP principal function shall be to perform the following functions:

- A. Station selection of the ORBITAL DAP switches;
- B. Station selection of the MANUAL MODE TRANSLATION switches;
- C. Transformation and station selection of the MANUAL MODE ROTATIONAL switches; and
- D. Transformation of the MANUAL MODE ROTATIONAL PBI commands.

The switch signal processing shall be executed at the 6.25 Hz rate after GN&C SW RM and prior to ON-ORBIT DAP. The PBI command processing shall be executed at the 6.25 Hz rate after ON-ORBIT DAP.

The FC SWIT SOP interfaces are indicated by the functional block diagram on Figure 4.216-1. The parameter initialization requirements are shown in Table 4.216-1. The IDD inputs and outputs are listed in Tables 4.216-2 and 4.216-3. Values for the I-loads are contained in the I-load requirements document (JSC-19350); however, I-load definitions applicable to this principal function are listed in Table 4.216-4. K-loads are listed in Table 4.216-5. Constants are listed in Table 4.216-6.

| Table 4.216-1. FC Switch Processing Initialization Parameters | | | | | | | |
|---|-----------|-----------------------------------|------------|-------------|---------------|-------|-------|
| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
| DAP_AUTO | V95X2401X | DAP AUTO SELECT | | DISCRETE | 1 | | |
| DAP_INRTL | V95X2402X | DAP MANUAL INRTL HOLD SELECT | | DISCRETE | 0 | | |
| DAPLOAD_A | V95X2403X | DAPLOAD A SELECT | | DISCRETE | 1 | | |
| DAPLOAD_B | V95X2404X | DAPLOAD B SELECT | | DISCRETE | 0 | | |
| PRIMARY_RCS | V95X2409X | NORMAL RCS JETS | | DISCRETE | 1 | | |
| VERNIER_RCS | V95X2410X | VERNIER RCS JETS | | DISCRETE | 0 | | |
| DAP_LVLH | V95X2414X | DAP LVLH SELECT | | DISCRETE | 0 | | |
| TRANS_LOW_Z | V95X2415X | MAN MODE TRANS, Z LOW | | DISCRETE | 0 | | |
| TRANS_HIGH_Z | V95X2416X | MAN MODE TRANS, Z HIGH | | DISCRETE | 0 | | |
| TRANS_NORM(1) | V95X2417X | MAN MODE TRANS, X NORM | | DISCRETE | 0 | | |
| TRANS_NORM(2) | V95X2418X | MAN MODE TRANS, Y NORM | | DISCRETE | 0 | | |
| TRANS_NORM(3) | V95X2419X | MAN MODE TRANS, Z NORM | | DISCRETE | 0 | | |
| TRANS_PULSE(1) | V95X2420X | MAN MODE TRANS, X PLSE | | DISCRETE | 1 | | |
| TRANS_PULSE(2) | V95X2421X | MAN MODE TRANS, Y PLSE | | DISCRETE | 1 | | |
| TRANS_PULSE(3) | V95X2422X | MAN MODE TRANS, Z PLSE | | DISCRETE | 1 | | |
| ROT_DISC(1) | V95X2430X | MAN MODE ROTATION, ROLL DISCRETE | | DISCRETE | 1 | | |
| ROT_DISC(2) | V95X2431X | MAN MODE ROTATION, PITCH DISCRETE | | DISCRETE | 1 | | |
| ROT_DISC(3) | V95X2432X | MAN MODE ROTATION, YAW DISCRETE | | DISCRETE | 1 | | |
| ROT_PULSE(1) | V95X2439X | MAN MODE ROTATION, ROLL PULSE | | DISCRETE | 0 | | |
| ROT_PULSE(2) | V95X2440X | MAN MODE ROTATION, PITCH PULSE | | DISCRETE | 0 | | |

Table 4.216-1. FC Switch Processing Initialization Parameters

| Name | MSID/MML | Description | Const Type | Signal Type | Nominal Value | Range | Units |
|--------------|-----------|----------------------------------|------------|-------------|---------------|-------|-------|
| ROT_PULSE(3) | V95X2441X | MAN MODE ROTATION, YAW PULSE | | DISCRETE | 0 | | |
| R_DISC_PBI | V72X6450X | AFT ROTATION ROLL DSCR (LIGHT) | | DISCRETE | 0 | | |
| P_DISC_PBI | V72X6470X | AFT ROTATION PITCH DSCR (LIGHT) | | DISCRETE | 0 | | |
| Y_DISC_PBI | V72X6473X | AFT ROTATION YAW DSCR (LIGHT) | | DISCRETE | 0 | | |
| R_PULSE_PBI | V72X6452X | AFT ROTATION ROLL PULSE (LIGHT) | | DISCRETE | 0 | | |
| P_PULSE_PBI | V72X6472X | AFT ROTATION PITCH PULSE (LIGHT) | | DISCRETE | 0 | | |
| Y_PULSE_PBI | V72X6475X | AFT ROTATION YAW PULSE (LIGHT) | | DISCRETE | 0 | | |
| DAP_FREE | V95X2405X | DAP MANUAL FREE DRIFT SELECT | | DISCRETE | 0 | | |
| SPARE_PBI | V95X2408X | SPARE PBI | | DISCRETE | 0 | | |
| ALT_PRCs | V95X2411X | ALT PRCs DAP MODE | | DISCRETE | 0 | | |

4.216.1 Orbital DAP/Translation Switch Processing

The Orbital DAP/translation switch processing function shall provide station selection for the following discrettes:

A. Orbital DAP

- SELECT A and B
- RCS JETS PRIM, ALT, and VERN
- CONTROL AUTO, INRTL, LVLH, and FREE

B. Translation Manual Mode

- SPARE PBI
- HIGH Z
- LOW Z
- NORM X, Y, and Z
- PULSE X, Y, and Z

These discrettes are inputs from the GN&C SW RM. The switches exist at the forward and aft crew stations.

The station select process shall form the logical “OR” of a selected forward station discrete with its corresponding selected aft station discrete.

Note that the forward and aft PBIs are subsequently illuminated by ON-ORBIT DAP.

4.216.2 Rotational Switch Processing

The RCS rotational switch processing function shall monitor the -X/-Z sense discrete, transform the aft station discrettes, and provide station selection for the following ROTATIONAL MANUAL MODE switches:

- DISCRETE ROLL, PITCH, and YAW
- PULSE ROLL, PITCH, and YAW

These discrettes are inputs from the GN&C SW RM. The switches exist at the forward and aft crew stations.

When the sense discrete indicates the “zero” state (–Z sense), the aft mode discrettes in each of the roll, pitch, and yaw axes shall be transformed into the yaw, pitch, and roll axes, respectively (mode discrettes in roll and yaw are interchanged and in pitch are unaltered). When the sense discrete indicates the “1” state (–X sense), the mode discrettes in each of the aft roll, pitch, and yaw axes are unaltered. These transformations shall result in the following:

| Aft Mode Inputs* | Transformed Aft Mode Outputs | |
|------------------|------------------------------|----------|
| | –X Sense | –Z Sense |
| ROLL | ROLL | YAW |
| PITCH | PITCH | PITCH |
| YAW | YAW | ROLL |

*For each of the DISCRETE and PULSE modes.

The station select process for the MANUAL MODE ROTATIONAL discrettes shall form the logical “OR” of a selected forward discrete with its corresponding transformed discrete.

4.216.3 Rotational PBI Illumination Commands

The rotational PBI illumination commands shall be generated by monitoring the –X/–Z sense discrete and transforming the ROTATIONAL PBI commands for the following ROTATIONAL MANUAL MODE PBIs:

- DISCRETE ROLL, PITCH, and YAW
- PULSE ROLL, PITCH, and YAW

These discrete commands are from the ON–ORBIT DAP and are used to illuminate the aft ROTATIONAL PBIs. The forward ROTATIONAL PBIs are illuminated directly by ON–ORBIT DAP.

When the sense discrete indicates the “zero” state (–Z sense), the aft PBI discrettes in each of the roll, pitch, and yaw axes shall be transformed into the yaw, pitch, and roll axes, respectively (PBI discrettes in roll and yaw are interchanged and in pitch are unaltered).

STS 83-0015-34
December 14, 2007

When the sense discrete indicates the “1” state (-X sense), the PBI discrettes in the roll, pitch, and yaw are unaltered. These transformations shall result in the following:

| Aft PBI Inputs* | Transformed Aft PBI Outputs | |
|--|--------------------------------|----------|
| | -X Sense | -Z Sense |
| ROLL | ROLL | YAW |
| PITCH | PITCH | PITCH |
| YAW | YAW | ROLL |
| *For each of the DISCRETE and PULSE modes. | | |

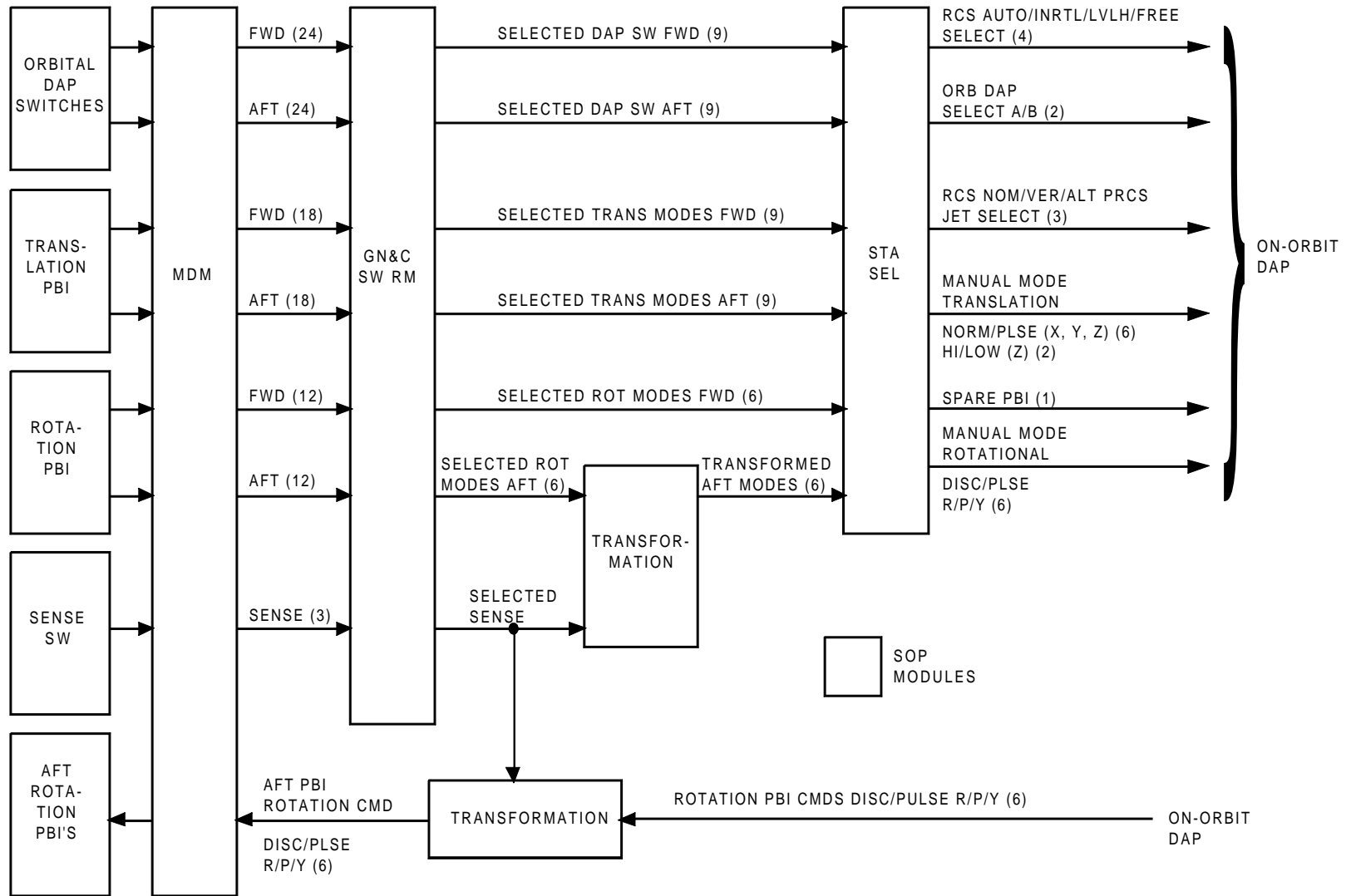


FIGURE 4.216-1. FC Switch SOP Functional Block Diagram

TABLE 4.216-2. INPUT FUNCTIONAL PARAMETERS FOR FLIGHT CONTROL SWITCH PROCESSOR (G4.216)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|------------------|-----------|----------------------------------|------------|-------|--------------|------------------|---------|-------------|
| AUTO_REQUEST | V90X7692X | SEL FWD DAP AUTO | GN&C SW RM | | | | 89688A | |
| DISC_REQUEST(1) | V90X7727X | SEL FWD ROTATION PITCH DISC RATE | GN&C SW RM | | | | 89688A | |
| DISC_REQUEST(2) | V90X7728X | SEL FWD ROTATION ROLL DISC RATE | GN&C SW RM | | | | 89688A | |
| DISC_REQUEST(3) | V90X7729X | SEL FWD ROTATION YAW DISC RATE | GN&C SW RM | | | | 89688A | |
| MANUAL_REQUEST | V90X7693X | SEL FWD DAP MAN/INRTL HOLD | GN&C SW RM | | | | 89688A | |
| PULSE_REQUEST(1) | V90X7730X | SEL FWD ROTATION PITCH PULSE | GN&C SW RM | | | | 89688A | |
| PULSE_REQUEST(2) | V90X7731X | SEL FWD ROTATION ROLL PULSE | GN&C SW RM | | | | 89688A | |
| PULSE_REQUEST(3) | V90X7732X | SEL FWD ROTATION YAW PULSE | GN&C SW RM | | | | 89688A | |
| ROT_DISC(1) | V90X2184X | AFT ROT LIGHT ROLL DSCR | ORB DAP | | | | 90900D | |
| ROT_DISC(2) | V90X2187X | AFT ROT LIGHT PITCH DSCR | ORB DAP | | | | 90900D | |
| ROT_DISC(3) | V90X2190X | AFT ROT LIGHT YAW DSCR | ORB DAP | | | | 90900D | |
| ROT_PULSE(1) | V90X2186X | AFT ROT LIGHT ROLL PULSE | ORB DAP | | | | 90900D | |
| ROT_PULSE(2) | V90X2189X | AFT ROT LIGHT PITCH PULSE | ORB DAP | | | | 90900D | |
| ROT_PULSE(3) | V90X2192X | AFT ROT LIGHT YAW PULSE | ORB DAP | | | | 90900D | |
| SENSE_SW | V90X7700X | SEL SENSE -X | GN&C SW RM | | BD | | 93017G | * |
| | V90X7690X | SEL FWD DAP SELECT A | GN&C SW RM | | | | | |
| | V90X7691X | SEL FWD DAP SELECT B | GN&C SW RM | | | | | |
| | V90X7702X | SEL AFT RCS JETS NORM | GN&C SW RM | | | | | |
| | V90X7703X | SEL AFT RCS JETS VERNIER | GN&C SW RM | | | | | |
| | V90X7707X | SEL AFT ROTATION PITCH DISC RATE | GN&C SW RM | | | | | |
| | V90X7708X | SEL AFT ROTATION ROLL DISC RATE | GN&C SW RM | | | | | |
| | V90X7709X | SEL AFT ROTATION YAW DISC RATE | GN&C SW RM | | | | | |
| | V90X7710X | SEL AFT ROTATION PITCH PULSE | GN&C SW RM | | | | | |
| | V90X7711X | SEL AFT ROTATION ROLL PULSE | GN&C SW RM | | | | | |
| | V90X7712X | SEL AFT ROTATION YAW PULSE | GN&C SW RM | | | | | |
| | V90X7713X | SEL AFT MANUAL LVLH | GN&C SW RM | | | | | |
| | V90X7714X | SEL AFT TRANSLATION Z LOW | GN&C SW RM | | | | | |
| | V90X7715X | SEL AFT TRANSLATION Z HIGH | GN&C SW RM | | | | | |
| | V90X7716X | SEL AFT TRANSLATION X NORM | GN&C SW RM | | | | | |
| | V90X7717X | SEL AFT TRANSLATION Y NORM | GN&C SW RM | | | | | |
| | V90X7718X | SEL AFT TRANSLATION Z NORM | GN&C SW RM | | | | | |
| | V90X7719X | SEL AFT TRANSLATION X PULSE | GN&C SW RM | | | | | |
| | V90X7720X | SEL AFT TRANSLATION Y PULSE | GN&C SW RM | | | | | |
| | V90X7721X | SEL AFT TRANSLATION Z PULSE | GN&C SW RM | | | | | |
| | V90X7722X | SEL FWD RCS JETS NORM | GN&C SW RM | | | | | |
| | V90X7723X | SEL FWD RCS JETS VERNIER | GN&C SW RM | | | | | |
| | V90X7733X | SEL FWD MANUAL LVLH | GN&C SW RM | | | | | |
| | V90X7734X | SEL FWD TRANSLATION Z LOW | GN&C SW RM | | | | | |
| | V90X7735X | SEL FWD TRANSLATION Z HIGH | GN&C SW RM | | | | | |
| | V90X7736X | SEL FWD TRANSLATION X NORM | GN&C SW RM | | | | | |
| | V90X7737X | SEL FWD TRANSLATION Y NORM | GN&C SW RM | | | | | |
| | V90X7738X | SEL FWD TRANSLATION Z NORM | GN&C SW RM | | | | | |
| | V90X7739X | SEL FWD TRANSLATION X PULSE | GN&C SW RM | | | | | |
| | V90X7740X | SEL FWD TRANSLATION Y PULSE | GN&C SW RM | | | | | |
| | V90X7741X | SEL FWD TRANSLATION Z PULSE | GN&C SW RM | | | | | |
| | V90X8002X | SEL FWD MAN FREE DRIFT | GN&C SW RM | | BD | | 89921C | |

TABLE 4.216-2. INPUT FUNCTIONAL PARAMETERS FOR FLIGHT CONTROL SWITCH PROCESSOR (G4.216)

| FSSR NAME | M/S ID | NOMENCLATURE | SOURCE | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|-----------|-----------|---------------------------|------------|-------|-----------|---------|---------|-------|
| | V90X8003X | SEL FWD ALT PRCS DAP MODE | GN&C SW RM | | BD | | 89921C | |
| | V90X8012X | SEL AFT MAN FREE DRIFT | GN&C SW RM | | BD | | 89921C | |
| | V90X8013X | SEL AFT ALT PRCS DAP MODE | GN&C SW RM | | BD | | 89921C | |
| | V90X8047X | SEL FWD SPARE PBI | GN&C SW RM | | BD | | 89921C | |
| | V90X8048X | SEL AFT SPARE PBI | GN&C SW RM | | BD | | 89921C | |
| | V90X8137X | SEL AFT DAP AUTO | GN&C SW RM | | | | | |
| | V90X8138X | SEL AFT DAP SELECT A | GN&C SW RM | | | | | |
| | V90X8142X | SEL AFT DAP MAN INRTL | GN&C SW RM | | | | 89921C | |
| | V90X8144X | SEL AFT DAP SELECT B | GN&C SW RM | | | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

This page intentionally left blank.

TABLE 4.216-3. OUTPUT FUNCTIONAL PARAMETERS FROM FLIGHT CONTROL SWITCH PROCESSOR (G4.216)

| FSSR NAME | M/S ID | NOMENCLATURE | DESTINATION | UNITS | DATA TYPE | P R E C | LAST CR | R E V |
|----------------|-----------|----------------------------------|-------------|-------|-----------|------------------|---------|-------------|
| ALT_PRCS | V95X2411X | ALT PRCS DAP MODE | ORB DAP | | BD | | 90900D | |
| DAPLOAD_A | V95X2403X | DAP LOAD A SELECT | ORB DAP | | | | | |
| DAPLOAD_B | V95X2404X | DAP LOAD B SELECT | ORB DAP | | | | | |
| DAP_AUTO | V95X2401X | DAP AUTO SELECT | ORB DAP | | | | | |
| DAP_FREE | V95X2405X | DAP MANUAL FREE DRIFT SELECT | ORB DAP | | BD | | 90900D | |
| DAP_INRTL | V95X2402X | DAP MANUAL INRTL HOLD SELECT | ORB DAP | | | | 90900D | |
| DAP_LVLH | V95X2414X | DAP LVLH SELECT | ORB DAP | | | | | |
| PRIMARY_RCS | V95X2409X | NORMAL RCS JETS | ORB DAP | | | | 90900D | |
| P_DISC_PBI | V72X6470X | AFT ROTATION PITCH DSCR (LIGHT) | D&C PNL | | BD | | | |
| P_PULSE_PBI | V72X6472X | AFT ROTATION PITCH PULSE (LIGHT) | D&C PNL | | BD | | | |
| ROT_DISC(1) | V95X2430X | MAN MODE ROTATION,ROLL DISCRETE | ORB DAP | | | | 90900D | |
| ROT_DISC(2) | V95X2431X | MAN MODE ROTATION,PITCH DISCRETE | ORB DAP | | | | 90900D | |
| ROT_DISC(3) | V95X2432X | MAN MODE ROTATION,YAW DISCRETE | ORB DAP | | | | 90900D | |
| ROT_PULSE(1) | V95X2439X | MAN MODE ROTATION,ROLL PULSE | ORB DAP | | | | 90900D | |
| ROT_PULSE(2) | V95X2440X | MAN MODE ROTATION,PITCH PULSE | ORB DAP | | | | 90900D | |
| ROT_PULSE(3) | V95X2441X | MAN MODE ROTATION,YAW PULSE | ORB DAP | | | | 90900D | |
| R_DISC_PBI | V72X6450X | AFT ROTATION ROLL DSCR (LIGHT) | D&C PNL | | BD | | | |
| R_PULSE_PBI | V72X6452X | AFT ROTATION ROLL PULSE (LIGHT) | D&C PNL | | BD | | | |
| SPARE_PBI | V95X2408X | SPARE PBI | ORB DAP | | BD | | 89921C | |
| TRANS_HIGH_Z | V95X2416X | MAN MODE TRANS,Z HIGH | ORB DAP | | | | 90900D | |
| TRANS_LOW_Z | V95X2415X | MAN MODE TRANS,Z LOW | ORB DAP | | | | 90900D | |
| TRANS_NORM(1) | V95X2417X | MAN MODE TRANS,X NORM | ORB DAP | | | | 90900D | |
| TRANS_NORM(2) | V95X2418X | MAN MODE TRANS,Y NORM | ORB DAP | | | | 90900D | |
| TRANS_NORM(3) | V95X2419X | MAN MODE TRANS,Z NORM | ORB DAP | | | | 90900D | |
| TRANS_PULSE(1) | V95X2420X | MAN MODE TRANS,X PLSE | ORB DAP | | | | 90900D | |
| TRANS_PULSE(2) | V95X2421X | MAN MODE TRANS,Y PLSE | ORB DAP | | | | 90900D | |
| TRANS_PULSE(3) | V95X2422X | MAN MODE TRANS,Z PLSE | ORB DAP | | | | 90900D | |
| VERNIER_RCS | V95X2410X | VERNIER RCS JETS | ORB DAP | | | | 90900D | |
| Y_DISC_PBI | V72X6473X | AFT ROTATION YAW DSCR (LIGHT) | D&C PNL | | BD | | | |
| Y_PULSE_PBI | V72X6475X | AFT ROTATION YAW PULSE (LIGHT) | D&C PNL | | BD | | | |

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

Rate Codes: (HDR Only) 1 = 1 sample/sec 2 = 5 samples/sec 3 = 12.5 samples/sec 4 = 25 samples/sec 5 = 100 samples/sec
 (HDR and LDR) A = 1 sample/sec B = 5 samples/sec C = 12.5 samples/sec D = 25 samples/sec E = 100 samples/sec

TABLE 4.216-4. FLIGHT CONTROL SWITCH PROCESSOR (G4.216) I-LOADS

| FSSR NAME | MSID | ENG UNITS | DT | PR | D | S | PR FCTN | MC | CAT | LAST CR | R E V |
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|
|-----------|------|-----------|----|----|---|---|---------|----|-----|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.216-5. FLIGHT CONTROL SWITCH PROCESSOR (G4.216) K-LOADS

| FSSR NAME DESCRIPTION | MSID | MC | KLOAD VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|-------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

TABLE 4.216-6. FLIGHT CONTROL SWITCH PROCESSOR (G4.216) CONSTANTS

| FSSR NAME DESCRIPTION | MSID | MC | CONSTANT VALUE | ENG UNITS | DT | P R | S | PR FCTN | LAST CR | R E V |
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|
|--------------------------|------|----|----------------|-----------|----|--------|---|---------|---------|-------------|

NO REQUIREMENTS

NOTE: REFERENCE TABLE 1.3-1 FOR EXPLANATION OF DATA ELEMENTS.

5.0 FORMULATIONS

Formulations of the detailed requirements consisting of top level and detailed structured flow charts are presented in this section. The structured flow charts indicate what must be done, and should not be construed to specify how it must be done. It must be noted that because these flow charts are not under configuration control, they may lag behind the design changes approved for Section 4, and should therefore be treated as information only.

Table 5–1 provides a cross–reference between the functions defined in Section 4 and the formulations provided here. Definitive notes for the SOP formulations are provided below:

A. Functional Module – A functional module is defined as a set of related functions grouped together which performs a specific task. A functional module may consist of algorithms and/or may schedule (i.e., call) other functional or common modules.

A functional module should not be confused with a software module which is defined as a set of software statements or code that implement a given function. It is assumed that the actual implementation of the functional module requirements will permit verification at the module level.

B. Common Module – A common module is similar to a functional module. A common module is called by functional modules or by other common modules to perform a specific common task. However, with each call, the common module operates on a variable list of parameters. The variable list of parameters is determined by the calling module. The common module input/output parameters are defined by data modules (see item C, below).

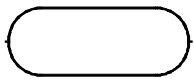
C. Data Module – The data modules define two categories of parameters. The REFERENCE category contains those parameters which are used by the common module as input reference data only. This category includes constants and variables which are required but whose values are not changed. The ASSIGN category contains those parameters which are either (i) required as input to the common module and are assigned new values, or (ii) generated by the common module and supplied as output data.

Data modules are specified for all common modules. Wherever possible, the data modules are included on the structured flow charts. In cases where the parameters in the data module are numerous, a table is referenced. All arrays within the data modules are designated by [brackets].

D. Array subscripts are denoted by use of parentheses; such as “Y(I)” to indicate the Ith element in the array [Y].

E. Except for the local parameters, the parameter names utilized are defined in the appropriate interface and initialization tables. The local parameters are described either in the text or by the data module tables.

F. Structured Flow Charts – Structured flow charts are used to indicate a formulation of the detailed requirements specified. Each flow chart begins at a terminal point and ends at a terminal point. Thus, only one entry and one return point is provided for each module. Between the terminals, mathematical equations and/or decisions are inserted to accomplish the desired task. Control within the flow is performed by the decision statements. Logic flow is generally from top to bottom and left to right; thus no arrowheads or connections are required on the flows. Figure 5–1 shows the structured flow chart legend used in this document. Note that “return in–line” means to return to the statement immediately below the decision. If there is no such statement, retrace path to the previous decision and repeat this logic.



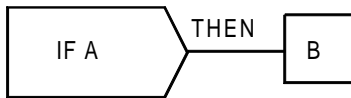
Terminal - identifies entry and return points. For entry points, the module name is generally inserted.



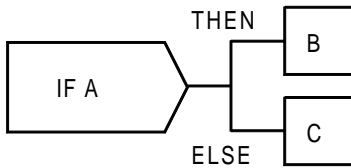
Mathematical statement/process control block which sometimes references another flow for a lower level of detail.



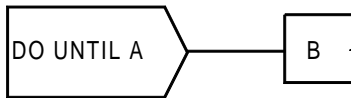
Decision statement block.



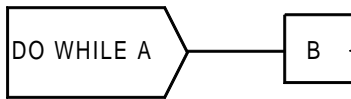
If A is true, then do B and return in-line (the word "then" is required).



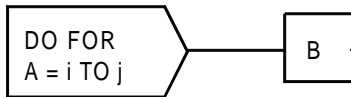
If A is true, then do B and return in-line; else do C and return in-line.



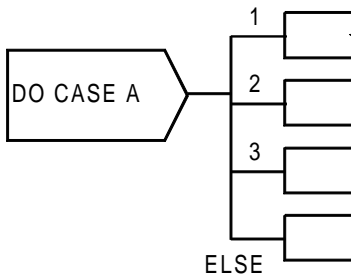
Do B until A is true, then return in-line. Note: The decision of A is made after doing B.



Do B while A is true, then return in-line. Note: The decision of A is made before doing B.



Do B while A increments from i to j, and then return in-line. The increment is by ones unless otherwise specified. Provision is also provided to skip values such as in "DO FOR A = 1, 2, 5, 6."



Do one of specified processes based on value of A, and then return in-line. Note: Some identification of each case index is given on the line leading into box, such as an index number, or the word ELSE (for branch taken if the case index is outside its valid range).

FIGURE 5-1. Structure Flow Chart Legend

Table 5-1. Requirements/Formulation Cross-Reference

| Principal Function | Section 4 Paragraph No. | Module Name | Figure No. |
|--------------------|-------------------------|--------------|------------|
| ADTA SOP | 4.39.2.1 | ADS_CALC | 5.39-1 |
| | 4.39.2.1.1 | AOA | 5.39-2 |
| | 4.39.2.1.2 | SSEC | 5.39-3 |
| | 4.39.2.1.3 | PSEC | 5.39-4 |
| | 4.39.2.1.4 | MACH | 5.39-5 |
| | 4.39.2.1.5 | PRALT | 5.39-6 |
| | 4.39.2.1.6 | PRALTC | 5.39-7 |
| | 4.39.2.1.7 | NSATM | 5.39-8 |
| | 4.39.2.1.8 | NSATMH | 5.39-9 |
| | 4.39.2.1.9 | STDATM | 5.39-10 |
| | 4.39.2.1.10 | DYPRS | 5.39-11 |
| | 4.39.2.1.11 | EQAS | 5.39-12 |
| | 4.39.2.1.12 | ETRAS | 5.39-13 |
| | 4.39.2.1.13 | DEFAD | 5.39-14 |
| | 4.39.2.1.14 | STLIM | 5.39-18 |
| | 4.39.2.3 | LR_CALC | 5.39-15 |
| | 4.39.2.4 | ADS_RM_CALC | 5.39-16 |
| | 4.39.2.3.1 | PARAT | 5.39-17 |
| ORB RG SOP | 4.40 | ORB_RG_COMP | 5.40-1 |
| | | DATAComp | 5.40-2 |
| SRB RG SOP | 4.41 | SRB_RG_COMP | 5.41-1 |
| AA SOP | 4.42 | AA_SOP | 5.42-1 |
| BF SLEW CMD SOP | 4.51 | BF_SLEW | 5.51-1 |
| 2-AX RHC SOP | 4.53 | RHC_SOP | 5.53-1 |
| | 4.53.1 | RHC_COMP | 5.53-2 |
| | 4.53.2 | RHC_DB | 5.53-3 |
| | 4.53.3 | RHC_DOWNMODE | 5.53-4 |
| | 4.53.4 | RHC_STS_SEL | 5.53-5 |
| | 4.53.5 | DEADBAND | 5.53-6 |
| | | PAN_RIM | 5.53-7 |
| | RHC_TRIM | 5.53-8 | |

| Table 5-1. Requirements/Formulation Cross-Reference | | | |
|---|-------------------------|------------------|------------|
| Principal Function | Section 4 Paragraph No. | Module Name | Figure No. |
| THC SOP | 4.54 | THC_SOP | 5.54-1 |
| | 4.54.1 | THC_TRANS | 5.54-2 |
| | 4.54.2 | THC_STA_SEL | 5.54-3 |
| SBTC SOP | 4.55 | SBTC_SOP | 5.55-1 |
| | 4.55.1 | SBTC_COMP | 5.55-2 |
| | 4.55.2 | SBTC_STA_SEL | 5.55-3 |
| | 4.55.3 | SBTC_MAN_THROT | 5.55-4 |
| RPTA SOP | 4.56 | RPTA_SOP | 5.56-1 |
| | 4.56.1 | RPTA_COMP | 5.56-2 |
| | 4.56.2 | RPTA_STA_SEL | 5.56-3 |
| | 4.56.3 | RPTA_DB | 5.56-4 |
| | 4.56.4 | YAW_TRIM | 5.56-5 |
| LANDING | 4.57 | LANDING_SOP | 5.57-1 |
| | | GEAR_PROC | 5.57-1 |
| 3-AX RHC SOP | 4.171 | 3_AX_RHC_SOP | 5.171-1 |
| | 4.171.1 | 3_AX_COMP | 5.171-2 |
| | 4.171.2 | 3_AX_VALID | 5.171-3 |
| | 4.171.3 | 3_AX_DB | 5.171-4 |
| | 4.171.4 | 3_AX_STA_SEL | 5.171-5 |
| | | 3_AX_DETENT | 5.171-6 |
| | | INT_STA_SEL | 5.171-7 |
| | | HYSTER_1 | 5.171-10 |
| | 4.171.5 | 3_AX_SOFTSTOP | 5.171-8 |
| | | DISC_STA_SEL | 5.171-9 |
| | | HYSTER_2 | 5.171-11 |
| ORB 3-AX RHC SOP | 4.199 | ORB_3AX_RHC_SOP | 5.199-1 |
| | 4.199.1 | ORB_3_COMP | 5.199-2 |
| | 4.199.2 | ORB_3_VALID | 5.199-3 |
| | 4.199.3 | ORB_3DB | 5.199-4 |
| | | RHC_SCALAR_TRANS | 5.199-5 |
| | | ORB_3_STA_SEL | 5.199-6 |
| | 4.199.4 | ORB_3DETENT | 5.199-7 |

Table 5-1. Requirements/Formulation Cross-Reference

| Principal Function | Section 4 Paragraph No. | Module Name | Figure No. |
|--------------------|-------------------------|------------------|------------|
| FC SWIT SOP | 4.199.5 | RHC_INT_TRANS | 5.199-8 |
| | | ORB_INT_STA_SEL | 5.199-9 |
| | | ORB_3_SOFTSTOP | 5.199-10 |
| | | RHC_DISC_TRANS | 5.199-11 |
| | | ORB_DISC_STA_SEL | 5.199-12 |
| | 4.216 | FC_SWIT_SOP | 5.216-1 |
| | 4.216.1 | DAP_TRANS_STASEL | 5.216-2 |
| | 4.216.2 | ROT_SW_TRANS | 5.216-3 |
| | 4.216.2 | ROT_SW_STASEL | 5.216-4 |
| | 4.216.3 | ROT_LAMP_CMD | 5.216-5 |

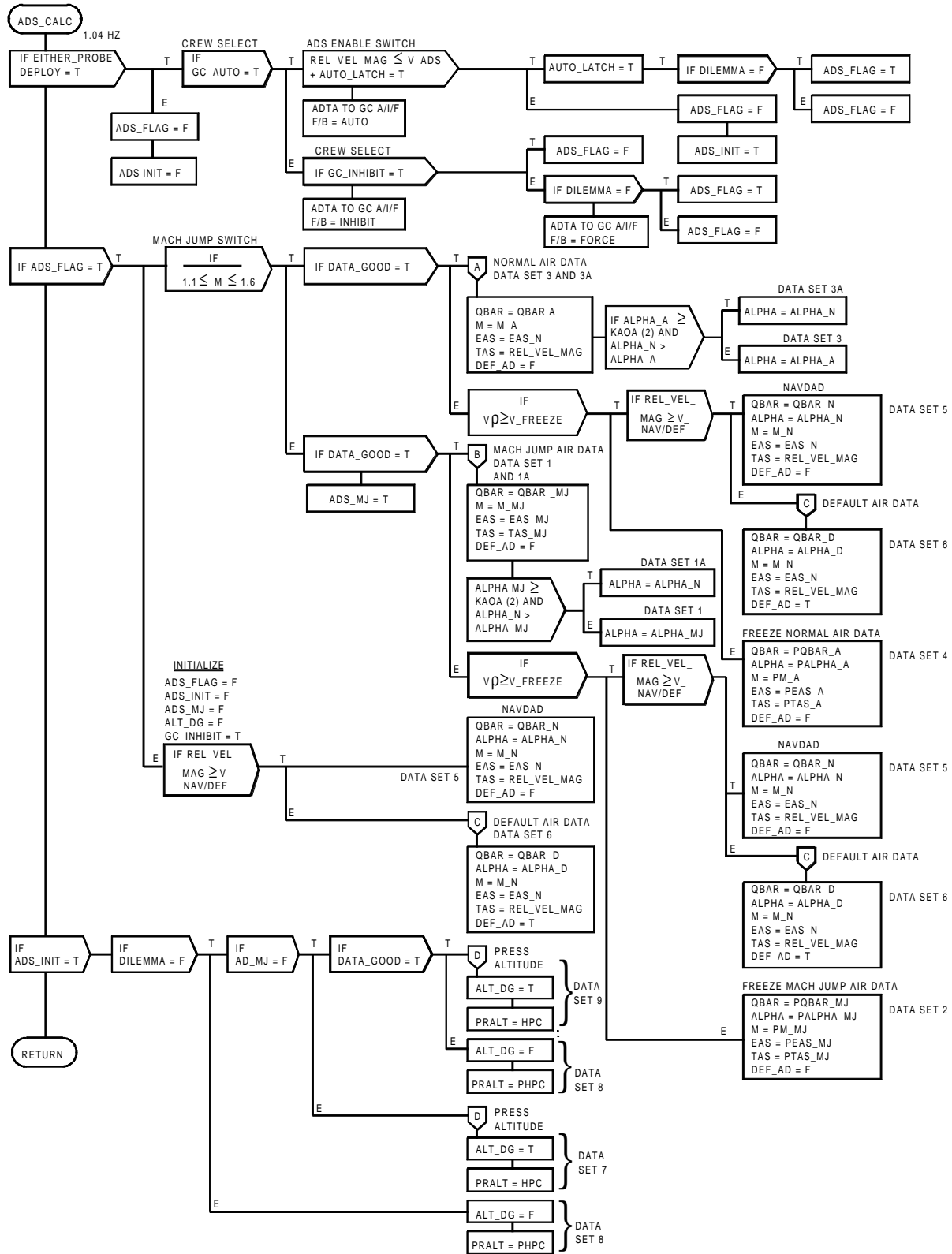


FIGURE 5.39-1.(1) ADS_CALC Functional Module (OPS 3) (Sheet 1 of 5)

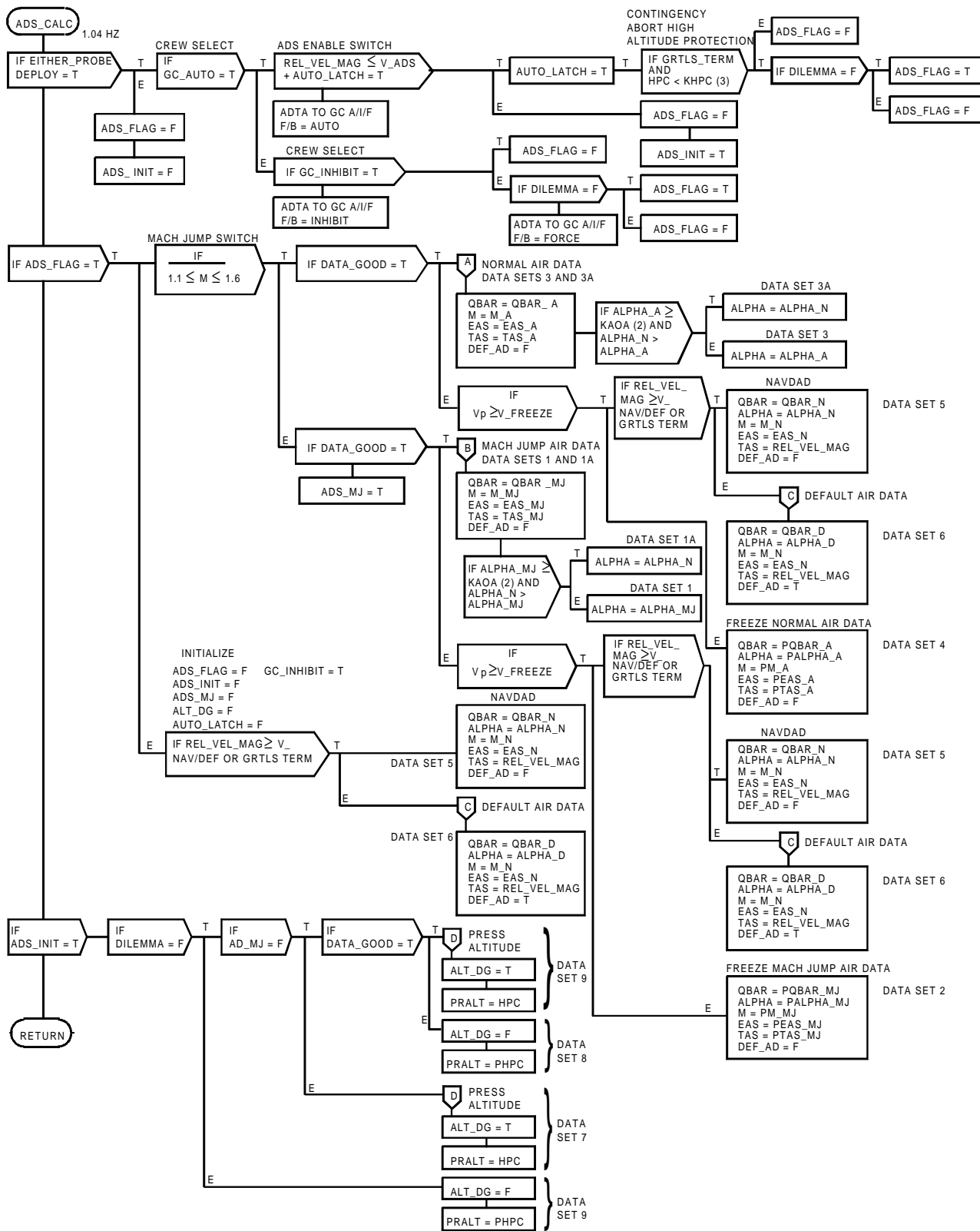


FIGURE 5.39-1.(2) ADS_CALC Functional Module (OPS 6) (Sheet 2 of 5)

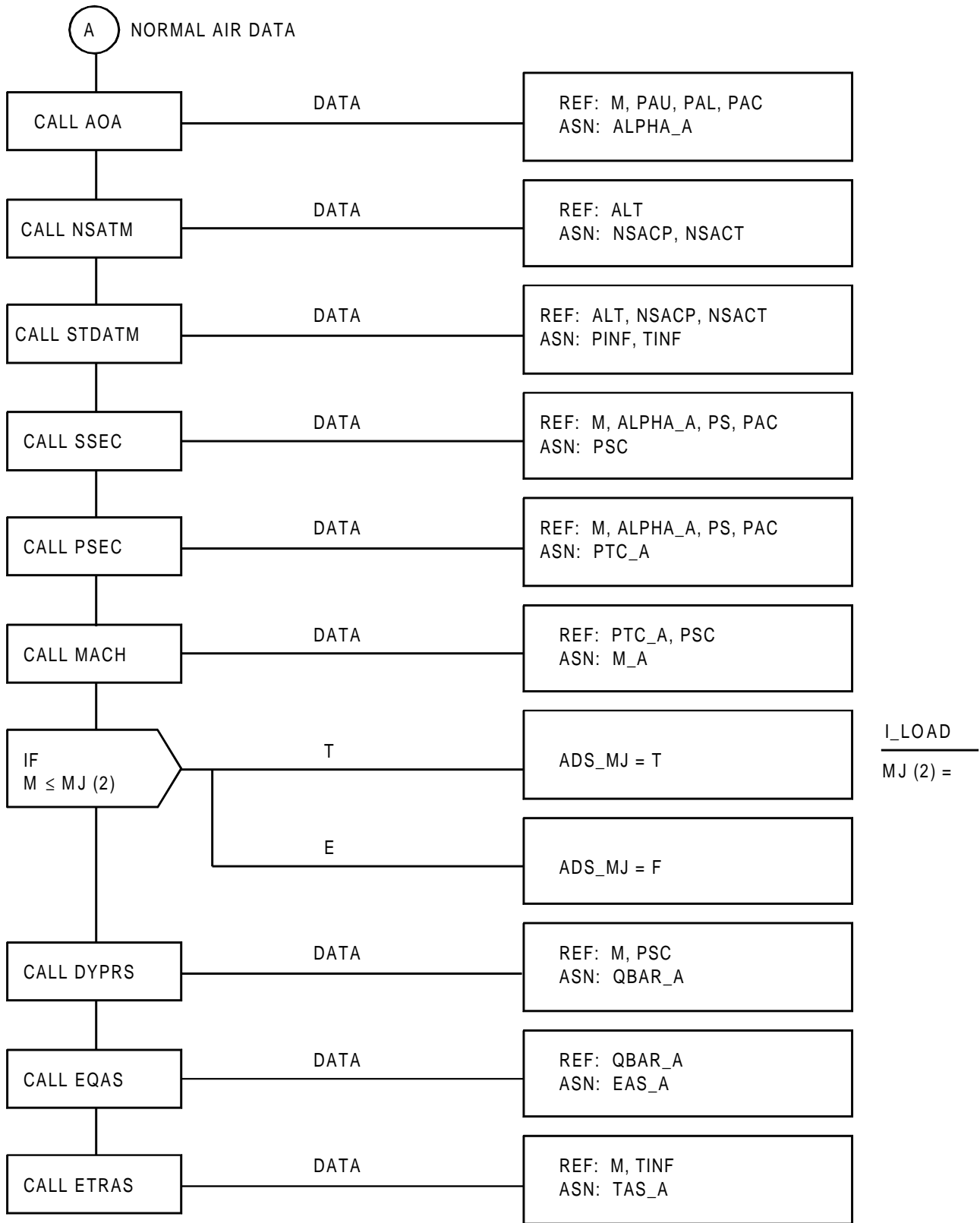


FIGURE 5.39-1.(3) ADS_CALC Functional Module (OPS 3 and 6) (Sheet 3 of 5)

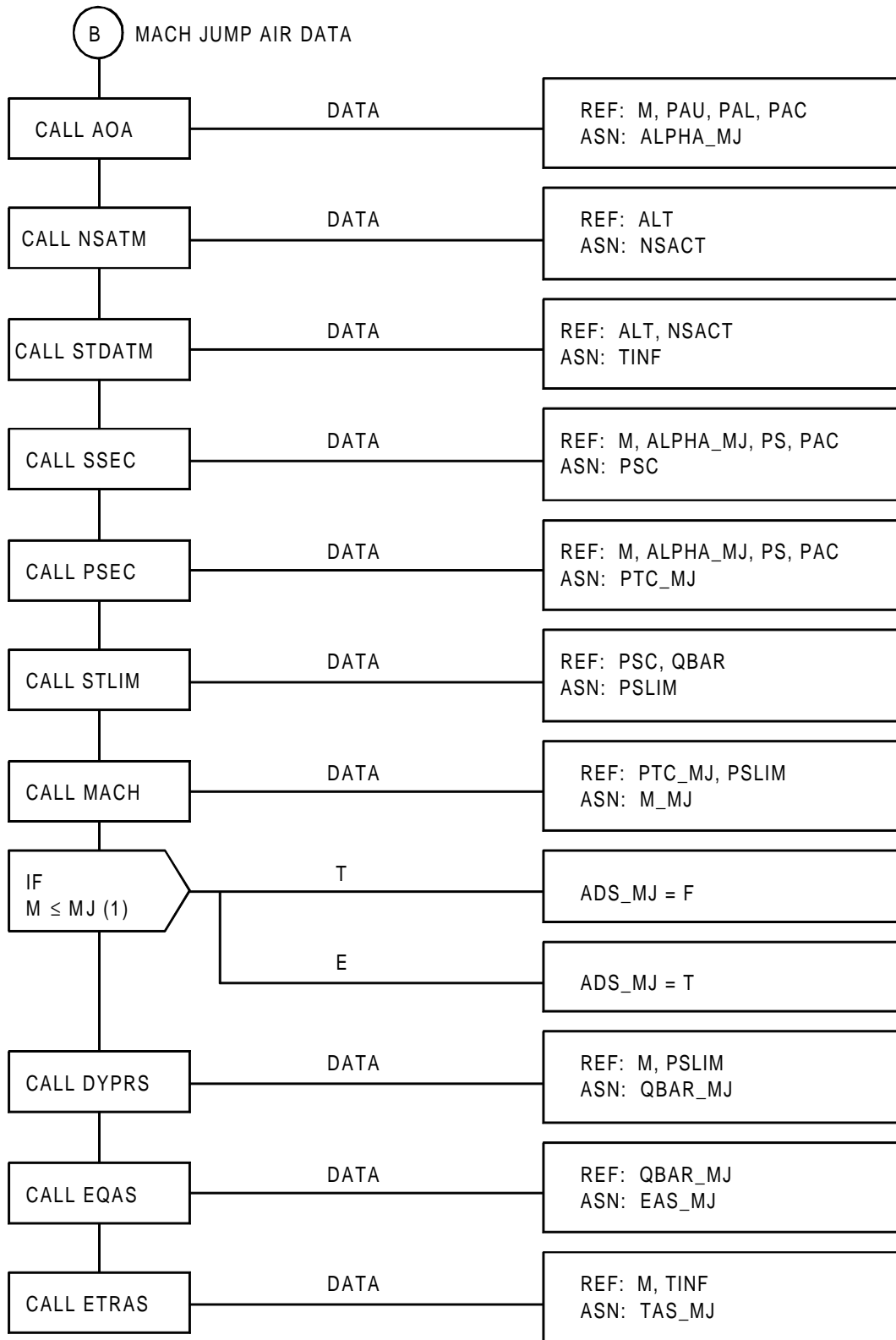


FIGURE 5.39-1.(4) ADS_CALC Functional Module (OPS 3 and 6) (Sheet 4 of 5)

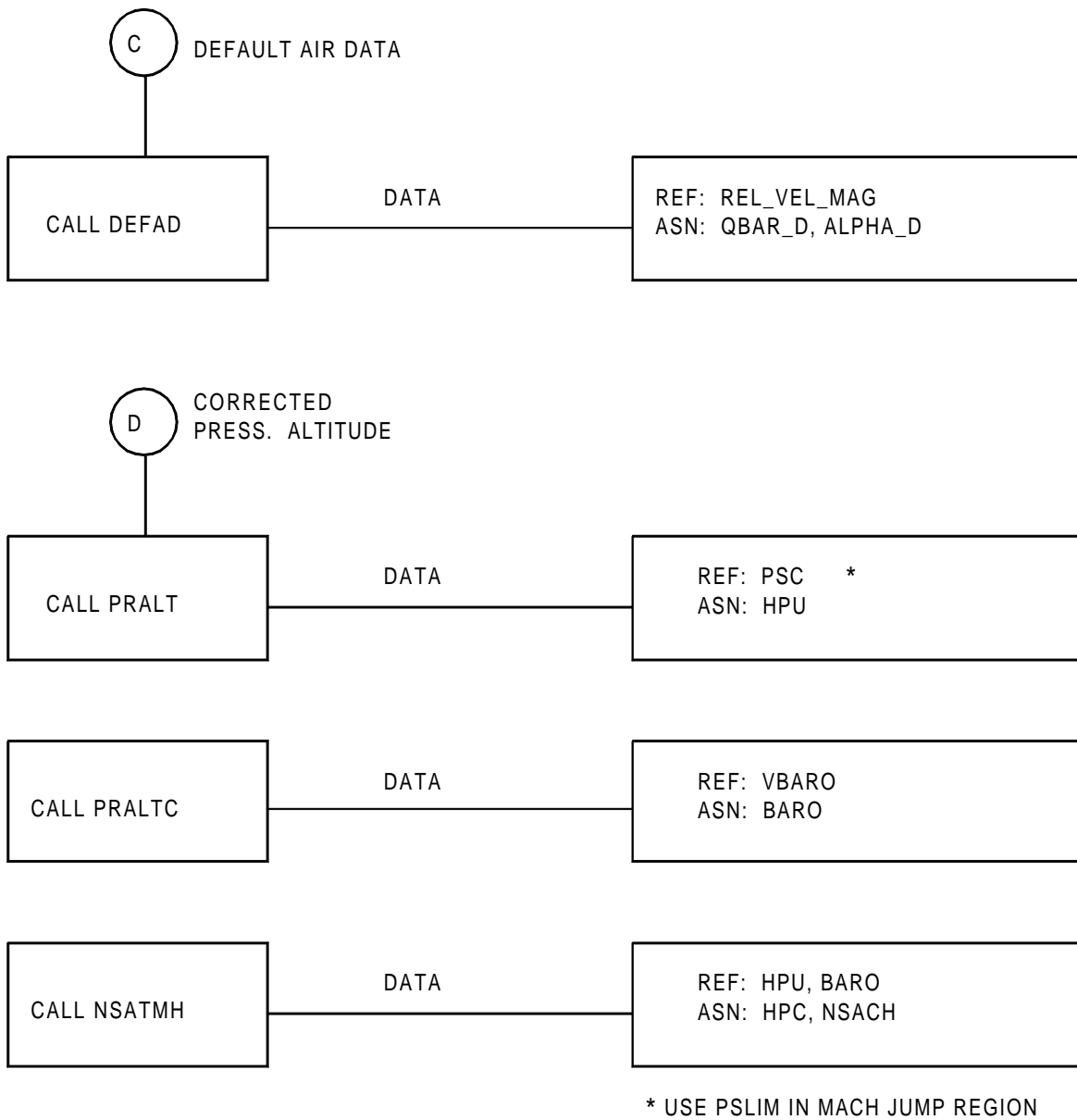


FIGURE 5.39-1.(5) ADS_CALC Functional Module (OPS 3 and 6) (Sheet 5 of 5)

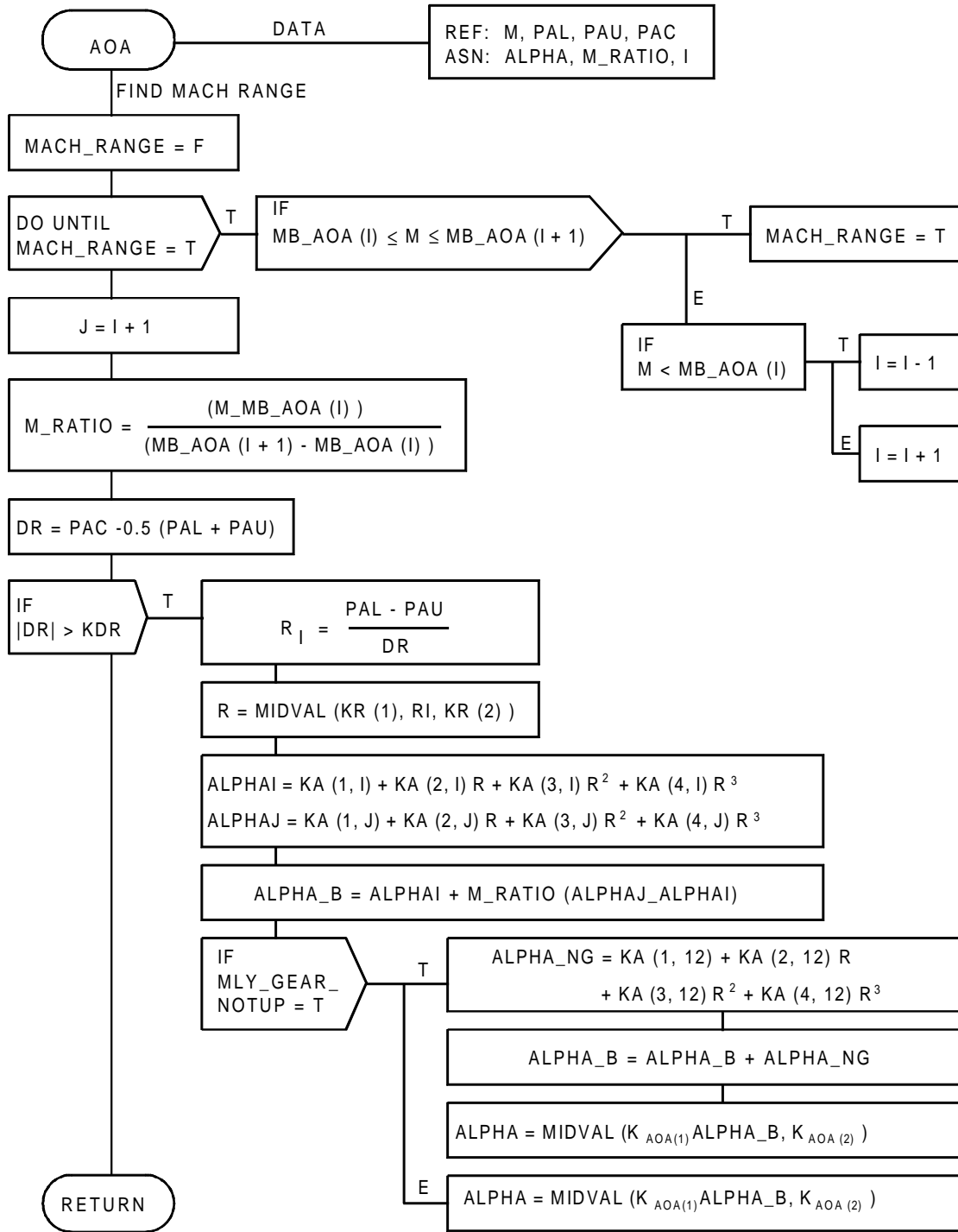


FIGURE 5.39-2. AOA Common Module

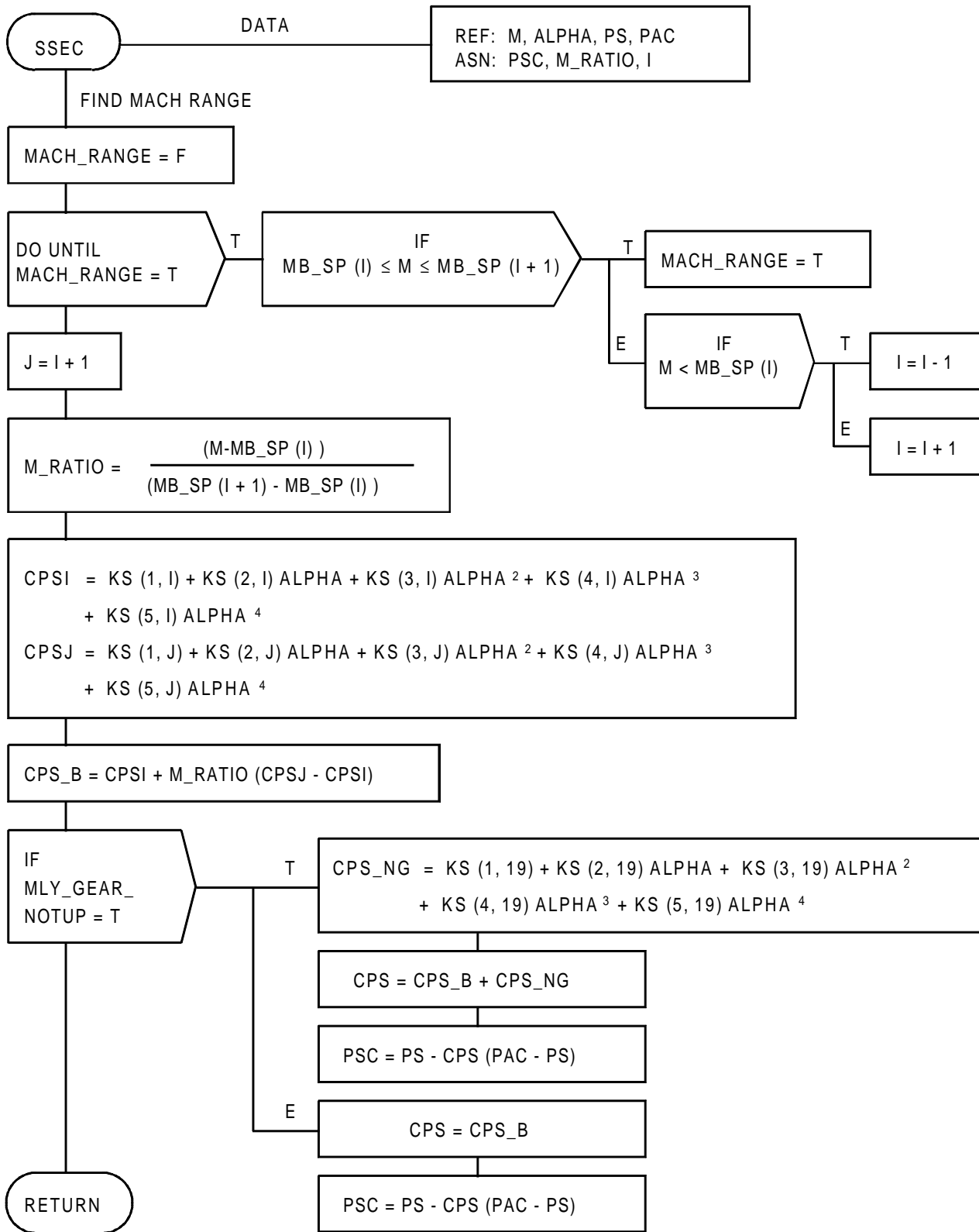


FIGURE 5.39-3. SSEC Common Module

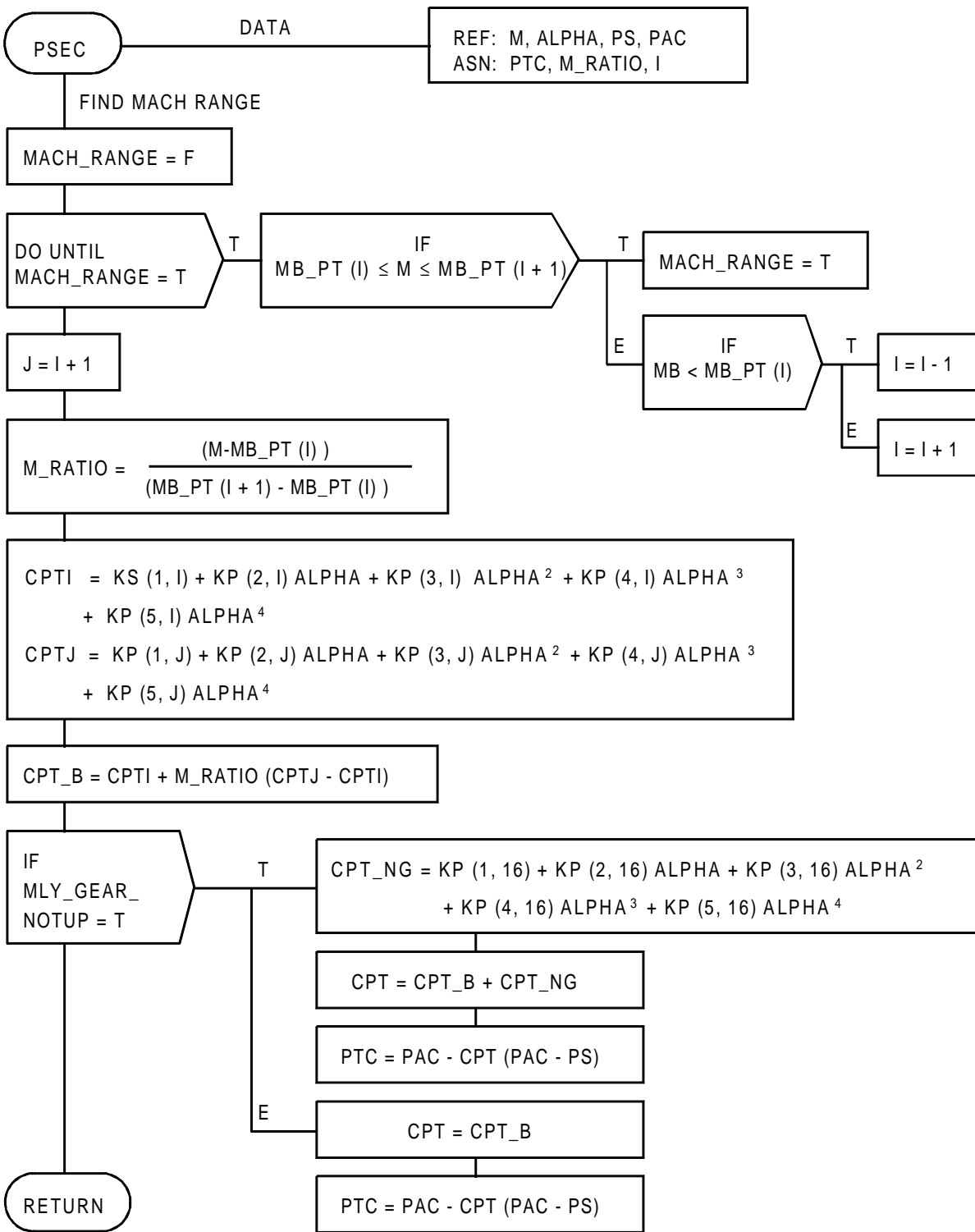
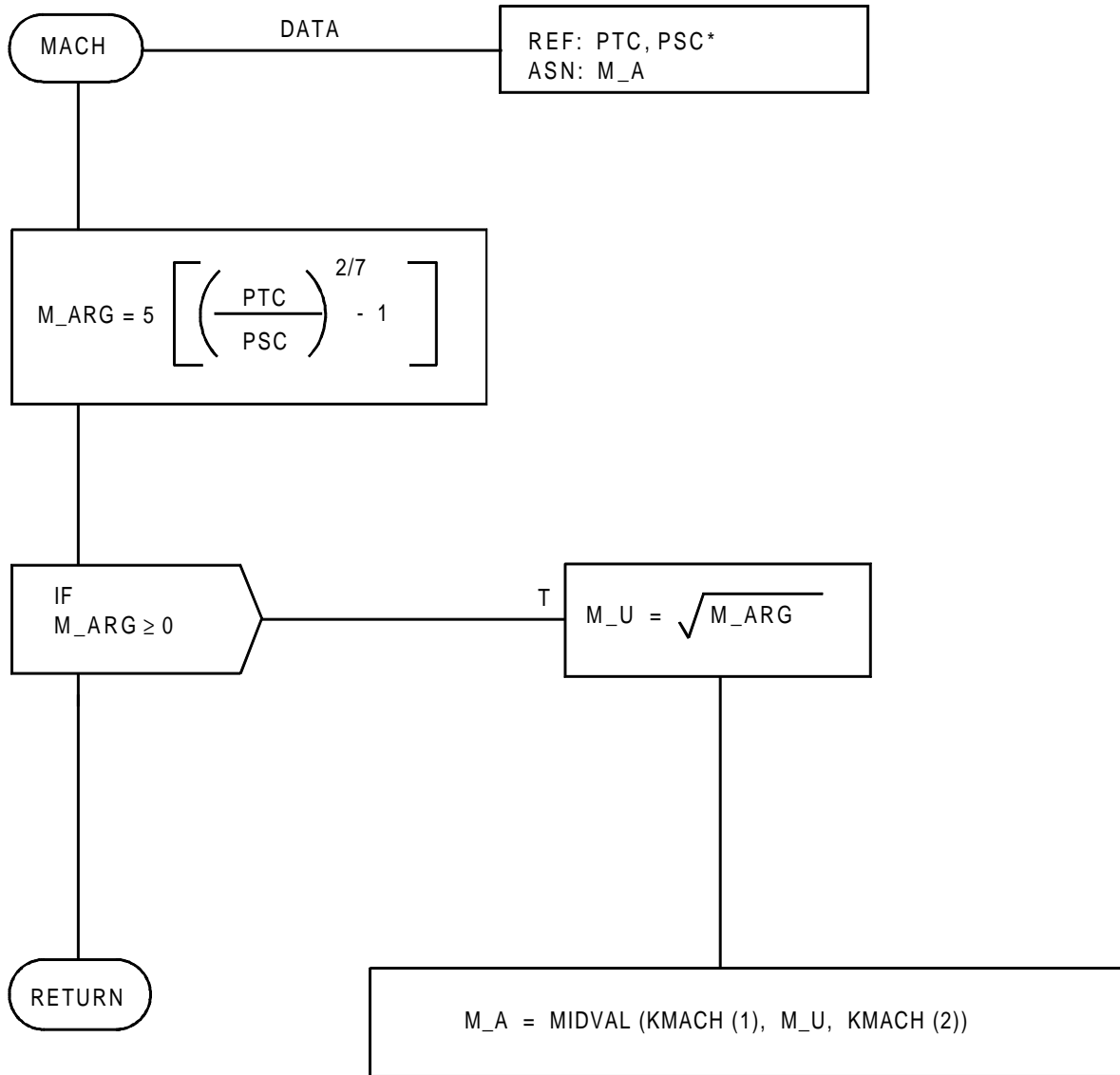
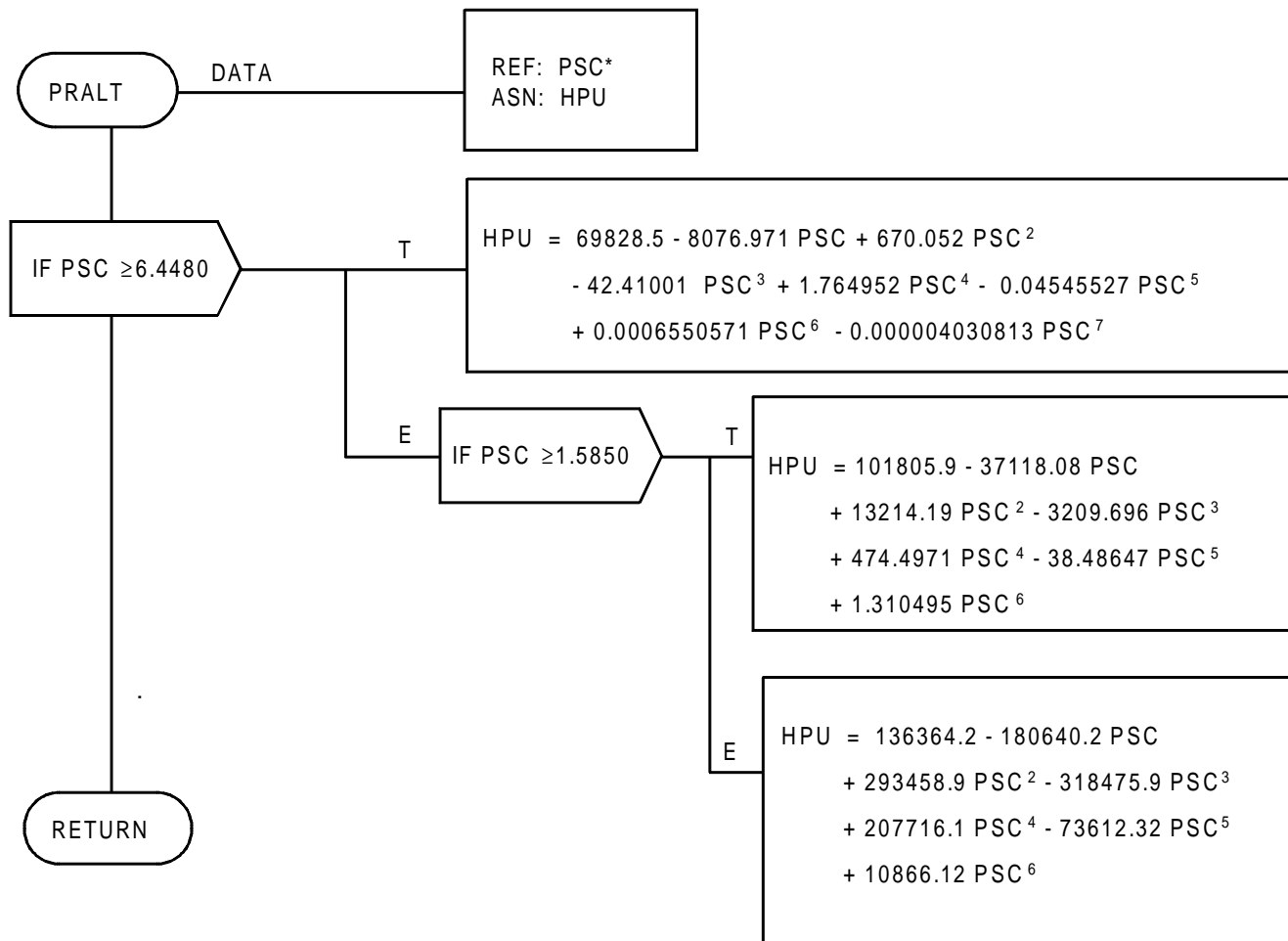


FIGURE 5.39-4. PSEC Common Module



* IN MACH JUMP REGION PSC = PSLIM

FIGURE 5.39-5. Mach Common Module



*USE PSLIM IN MACH JUMP REGION

FIGURE 5.39-6. PRALT Common Module

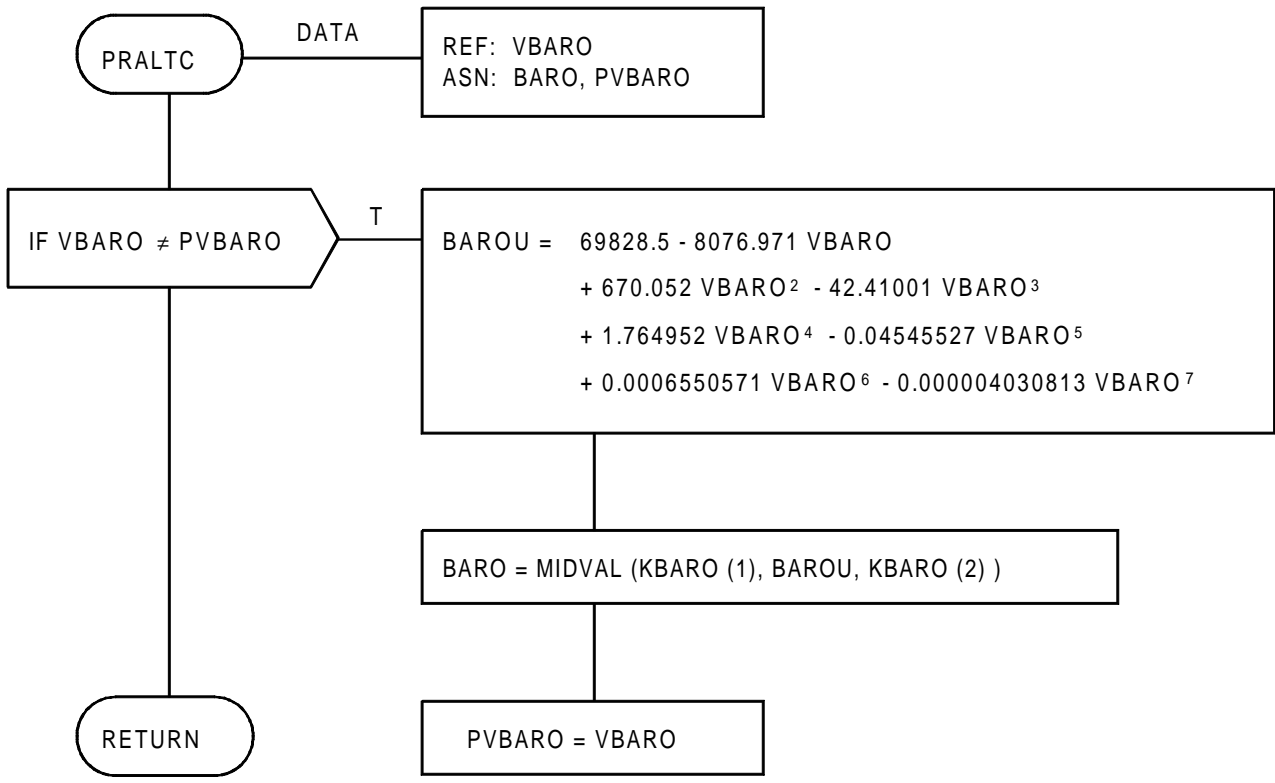


FIGURE 5.39-7. PRALTC Common Module

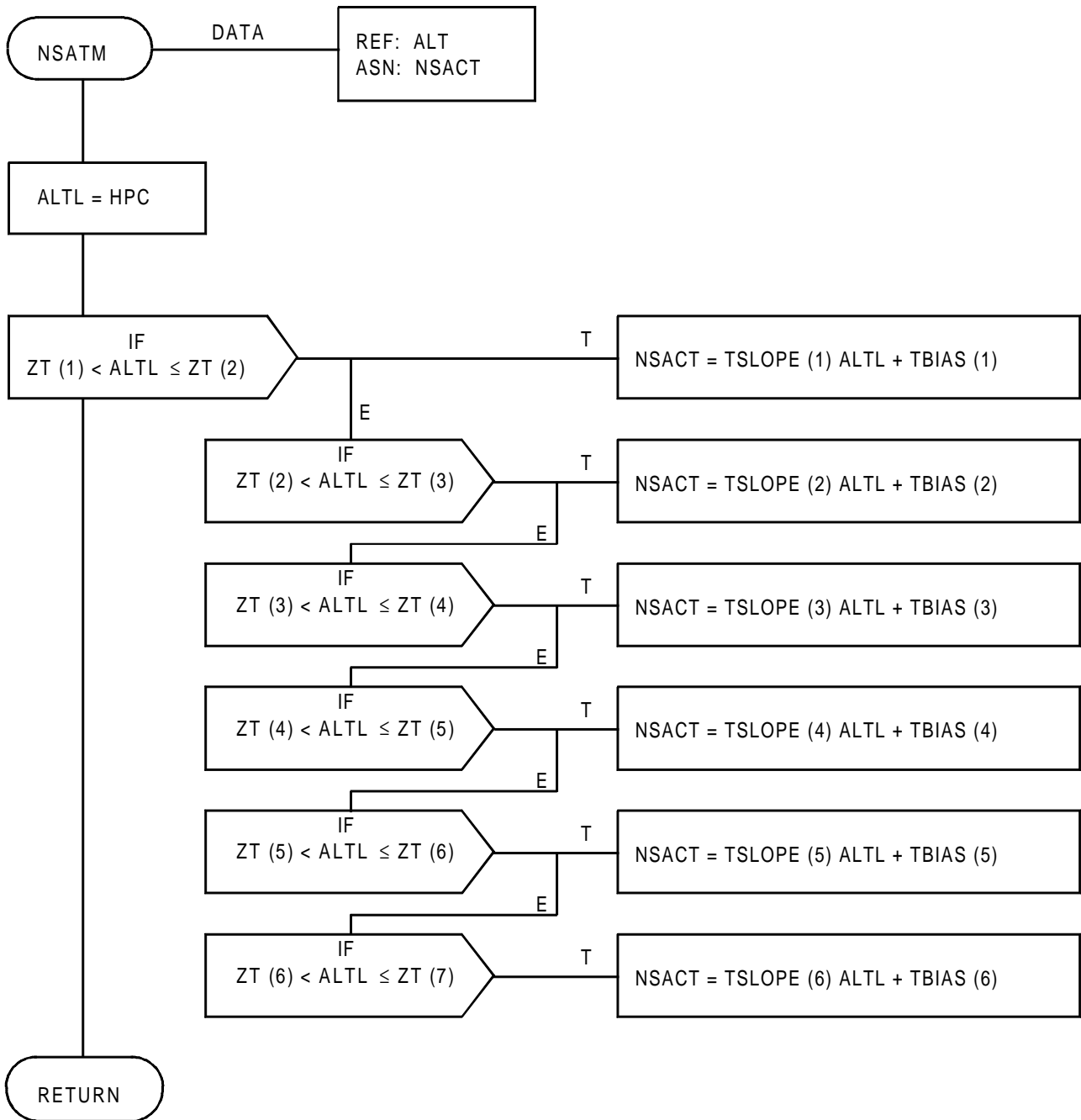


FIGURE 5.39-8. NSATM Common Module

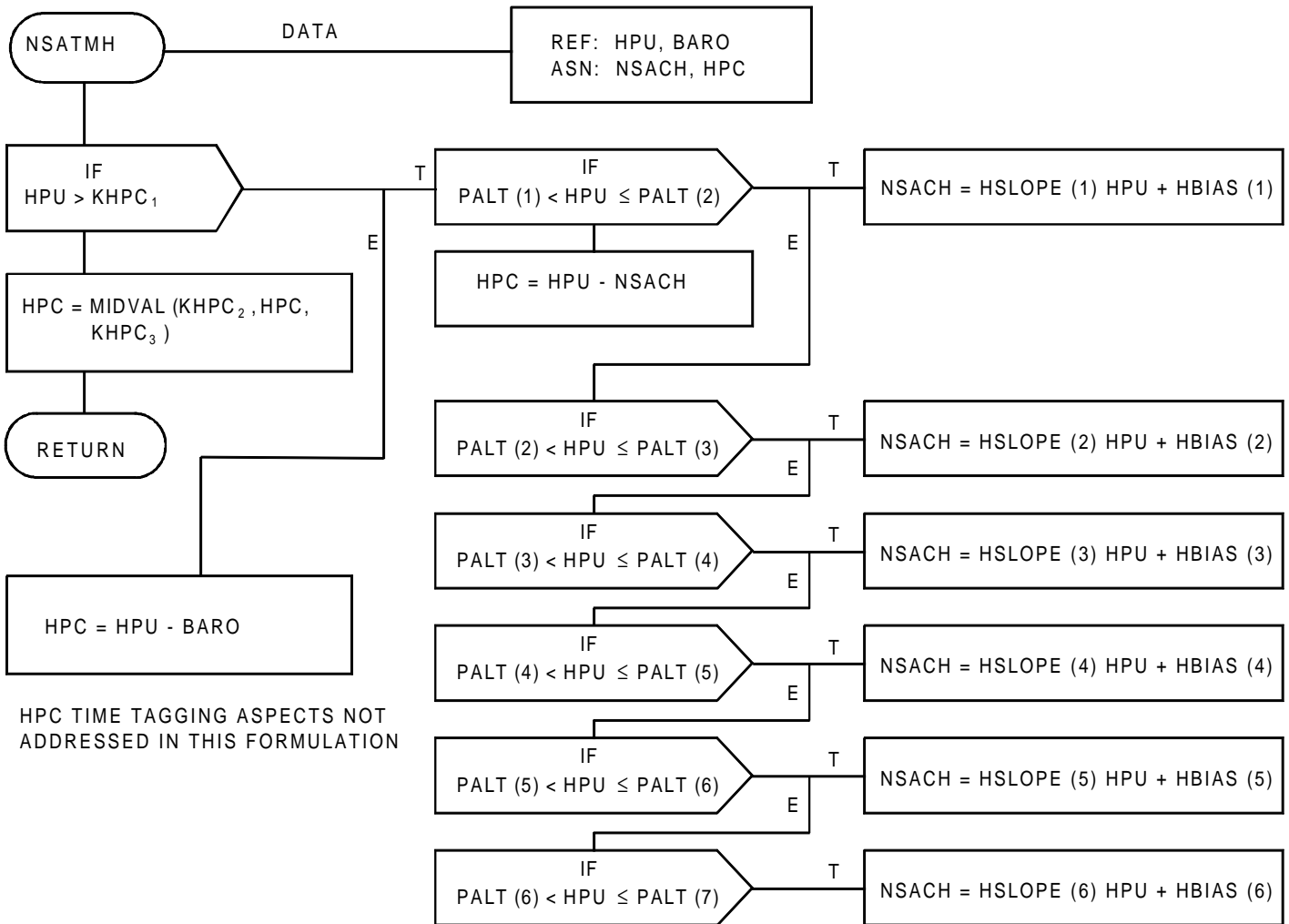


FIGURE 5.39-9. NSATMH Common Module

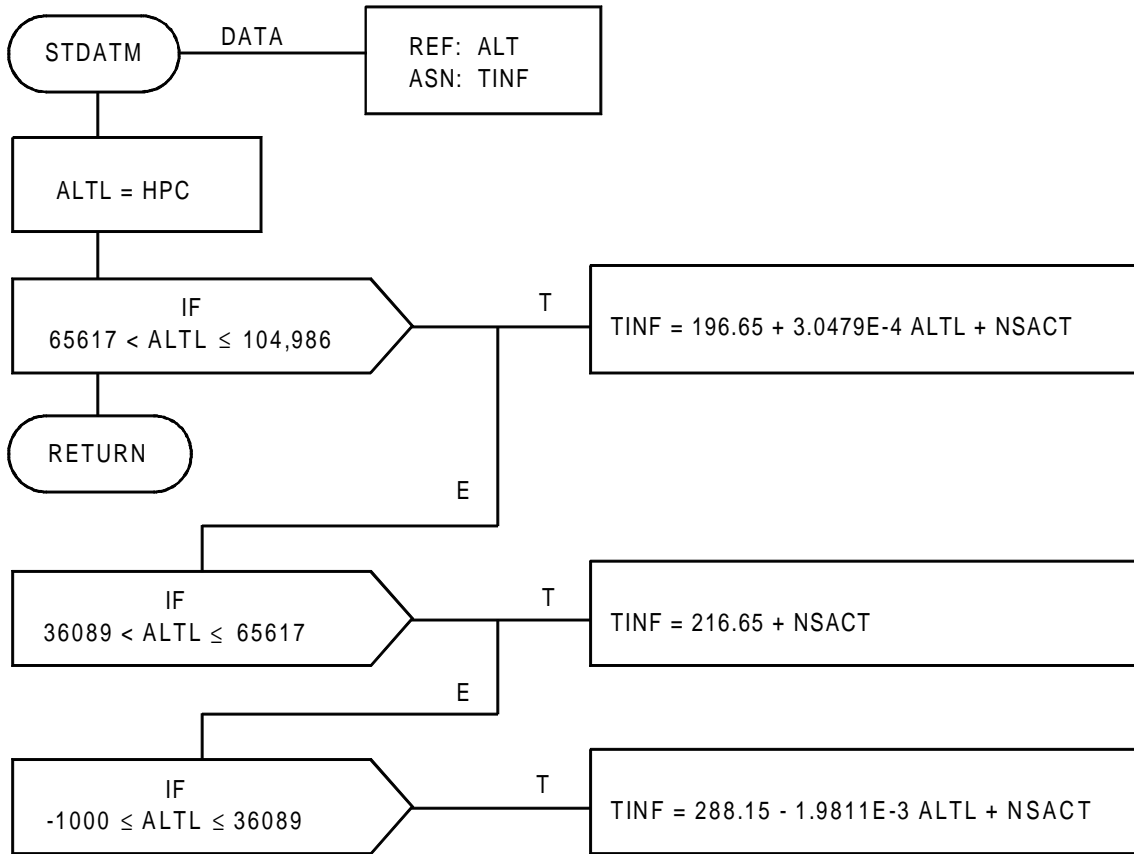
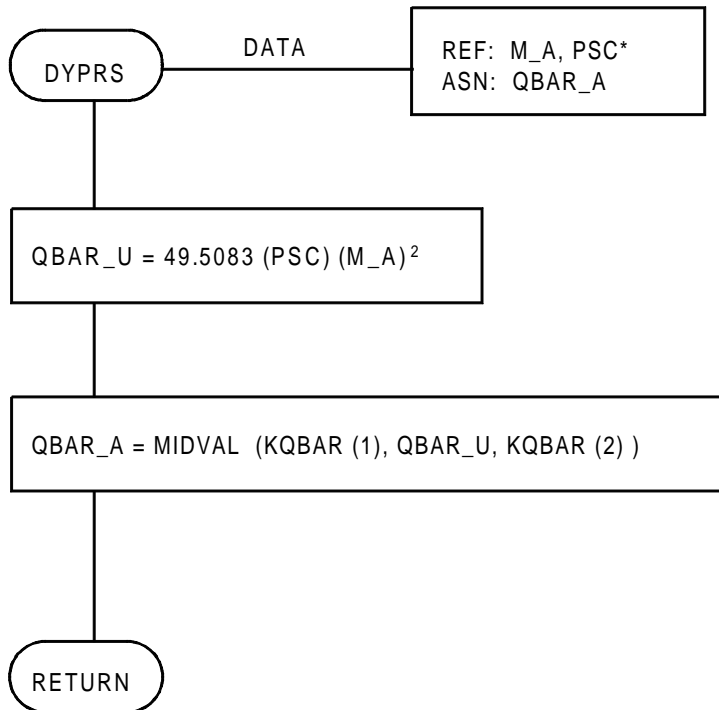


FIGURE 5.39-10. STDATM Common Module



* IN MACH JUMP REGION PSC = PSLIM

FIGURE 5.39-11. DYPRS Common Module

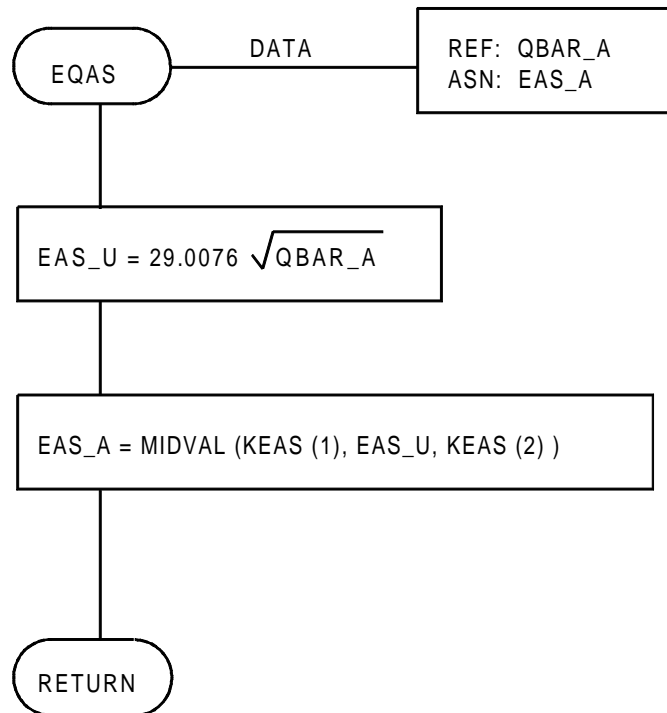


FIGURE 5.39-12. EQAS Common Module

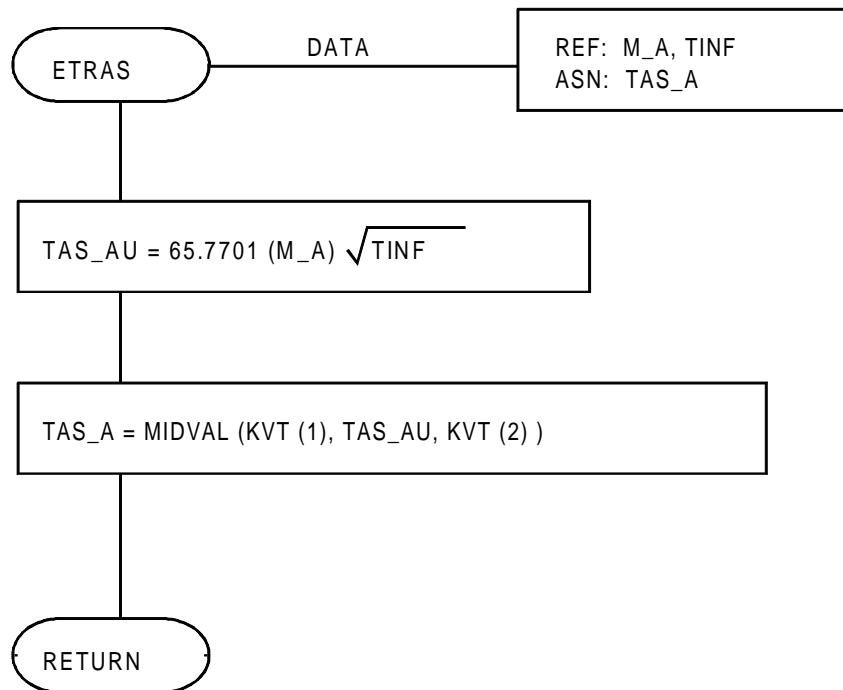


FIGURE 5.39-13. ETRAS Common Module

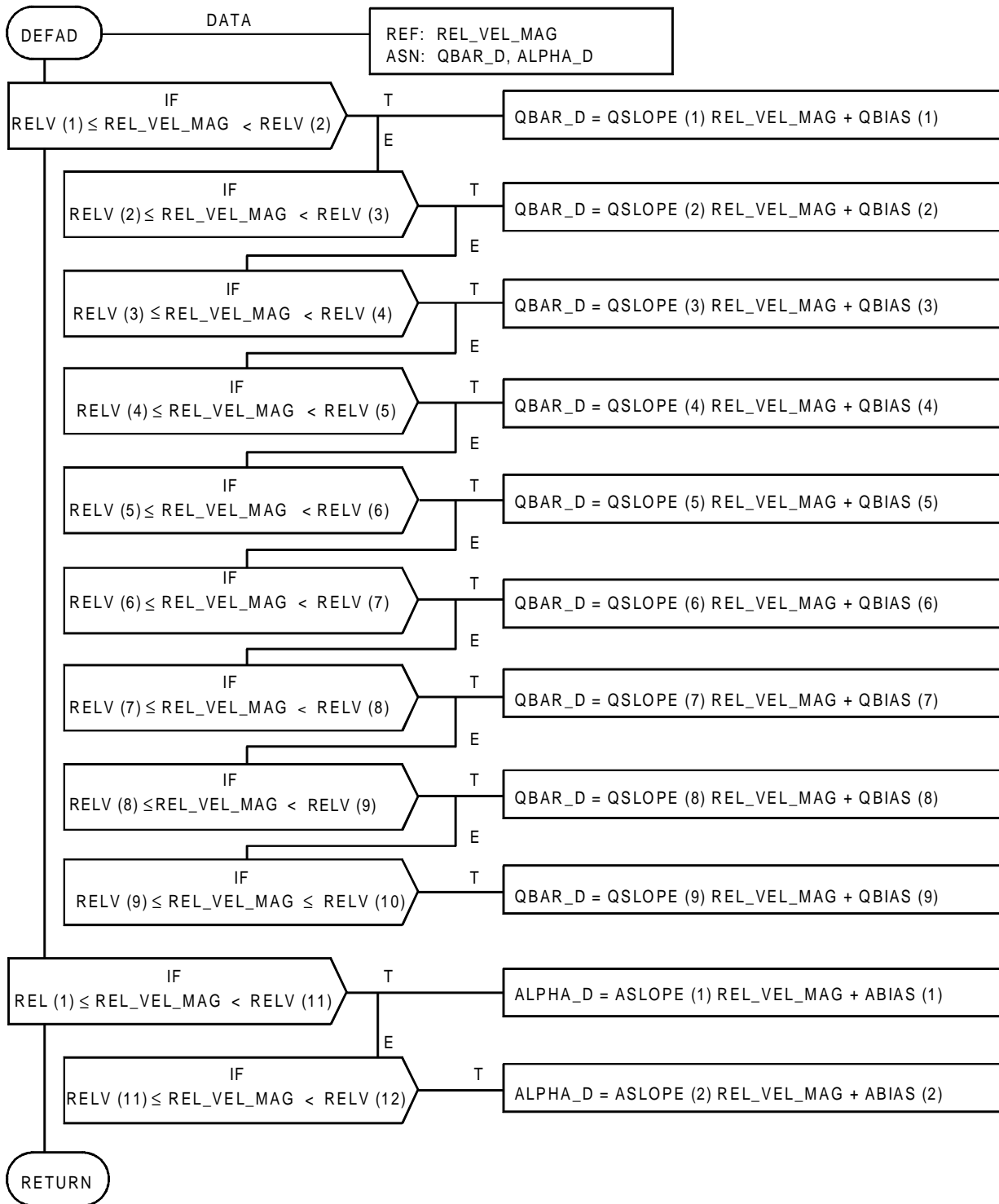


FIGURE 5.39-14. DEFAD Common Module

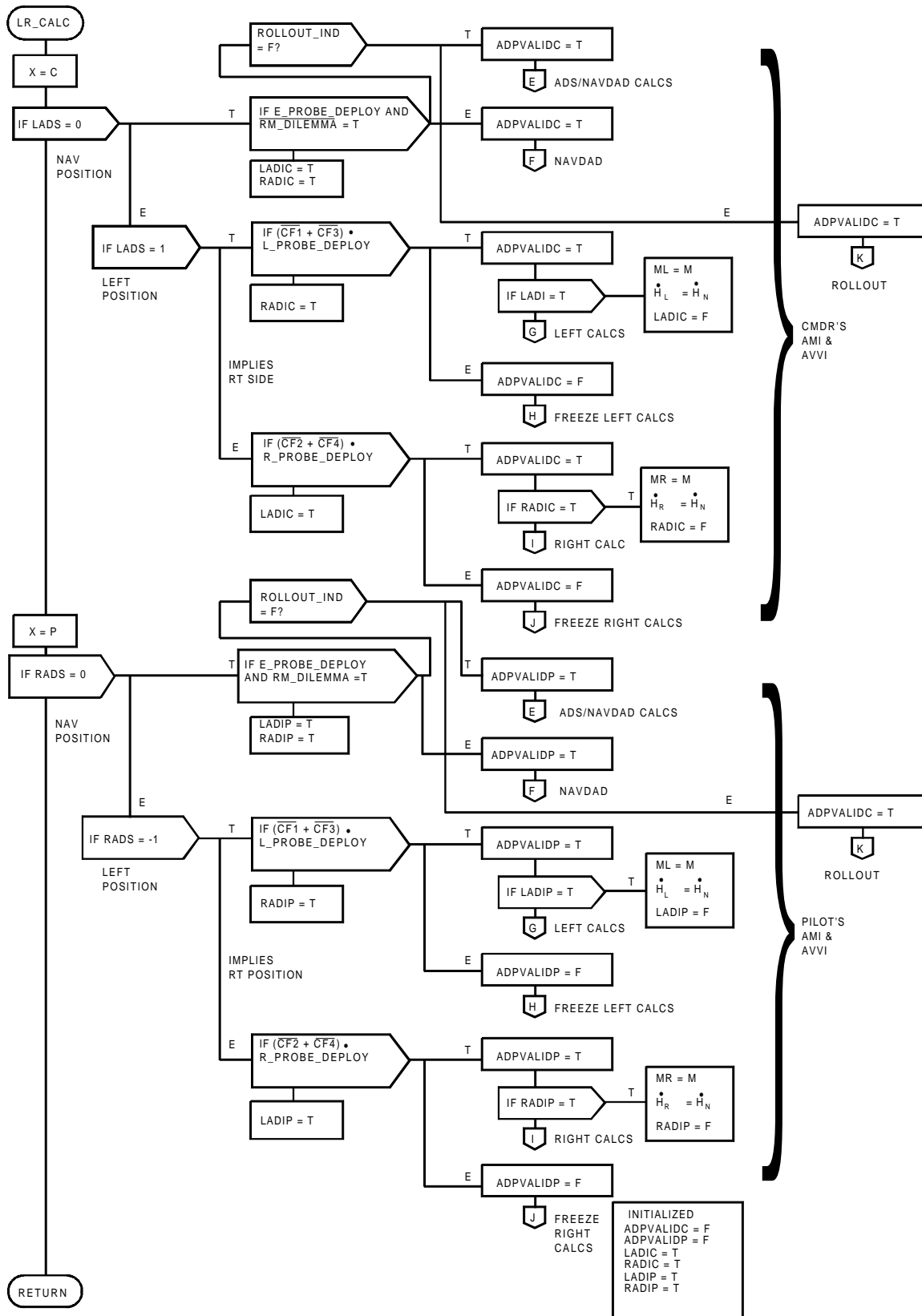


FIGURE 5.39-15.(1) LR_CALC Functional Module (Sheet 1 of 6)

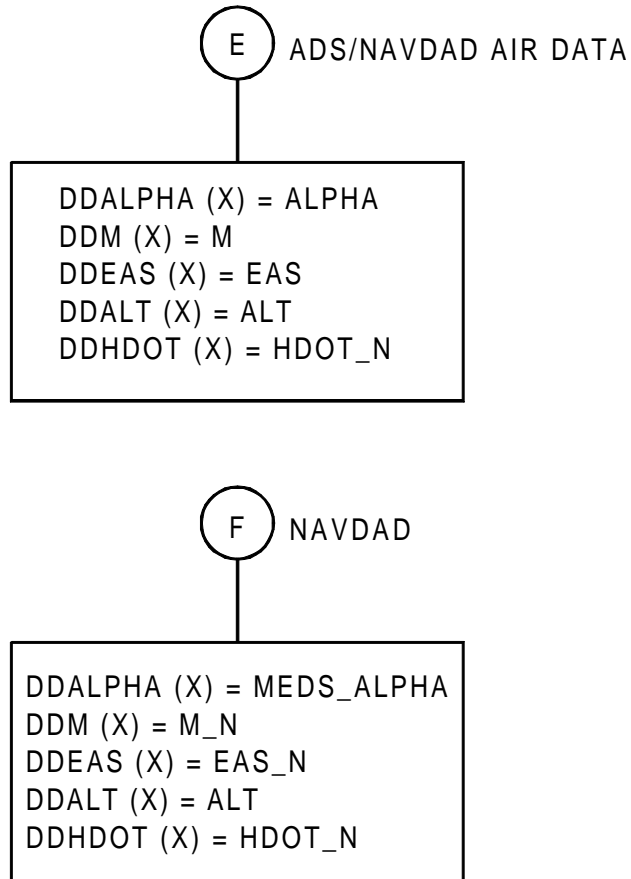


FIGURE 5.39-15.(2) LR_CALC Functional Module (Sheet 2 of 6)

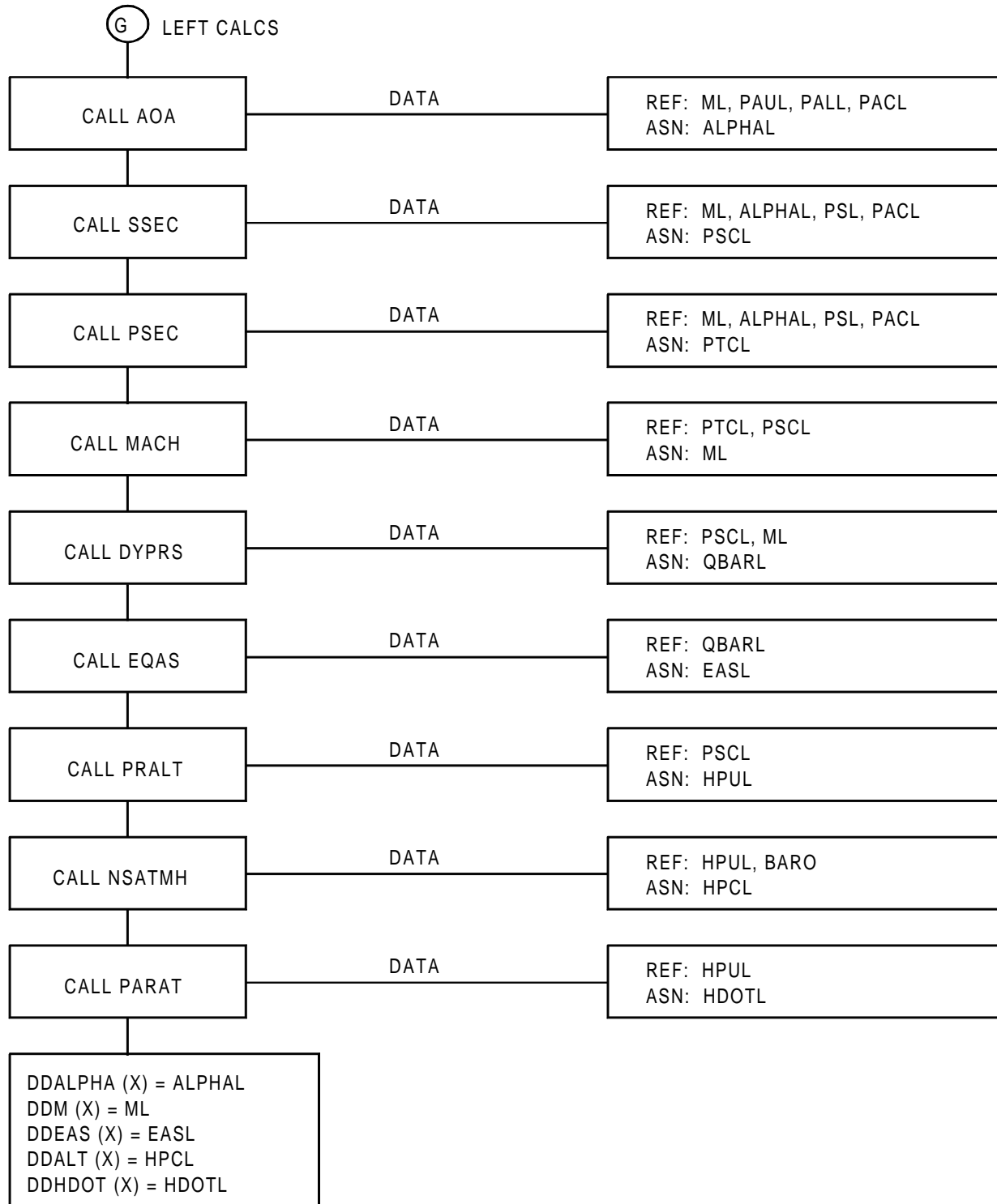


FIGURE 5.39-15.(3) LR_CALC Functional Module (Sheet 3 of 6)

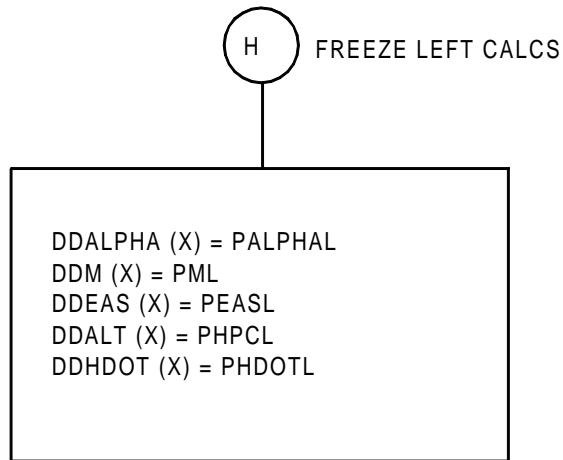


FIGURE 5.39-15.(4) LR_CALC Functional Module (Sheet 4 of 6)

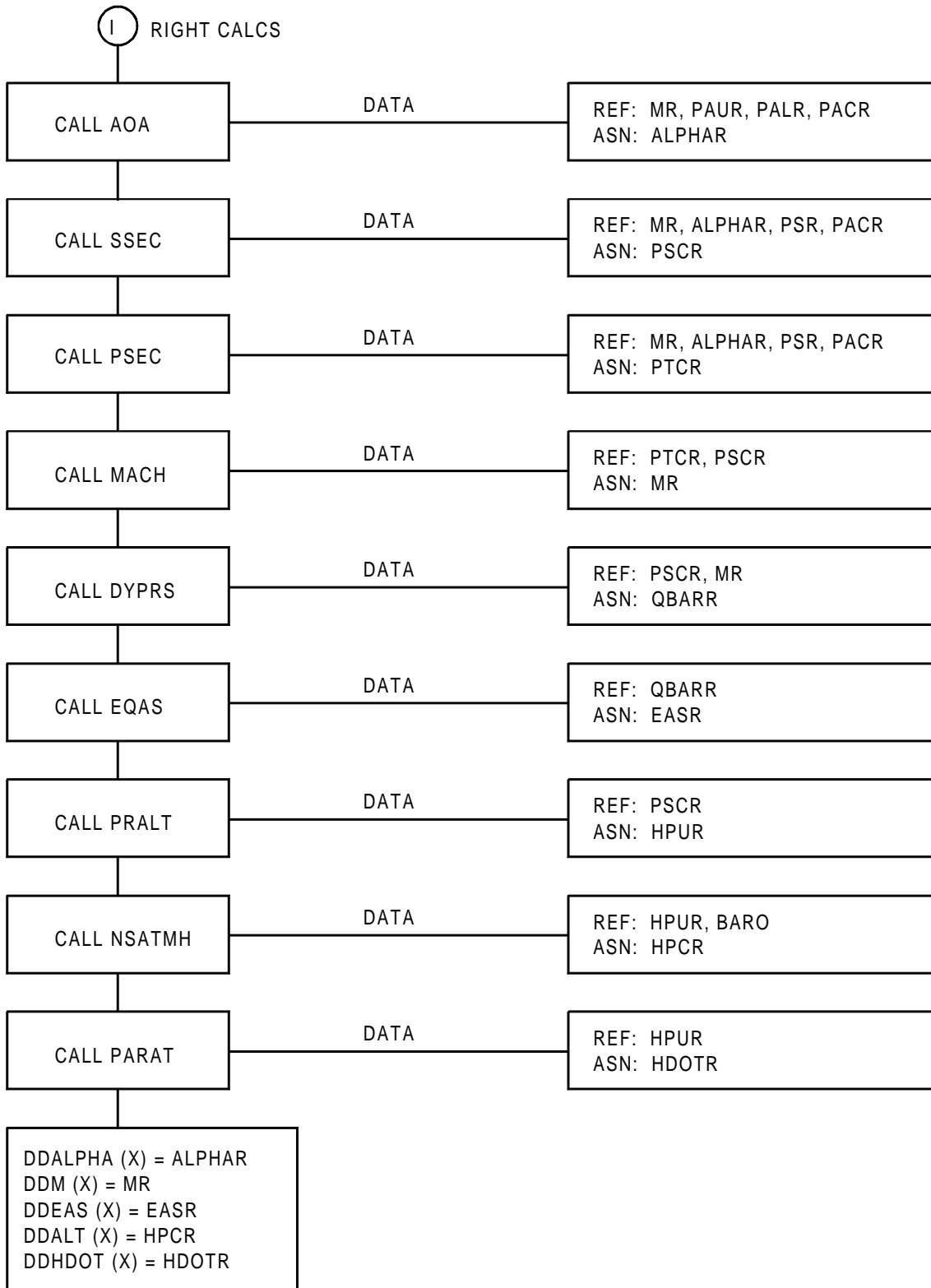


FIGURE 5.39-15.(5) LR_CALC Functional Module (Sheet 5 of 6)

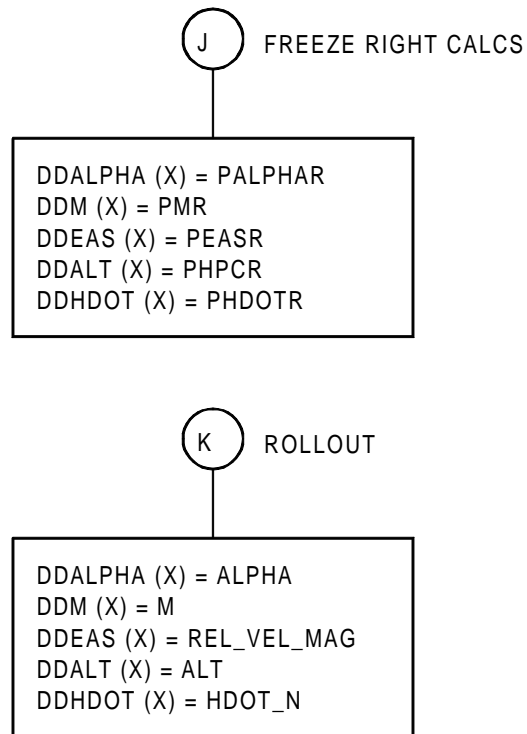


FIGURE 5.39-15.(6) LR_CALC Functional Module (Sheet 6 of 6)

This page intentionally left blank.

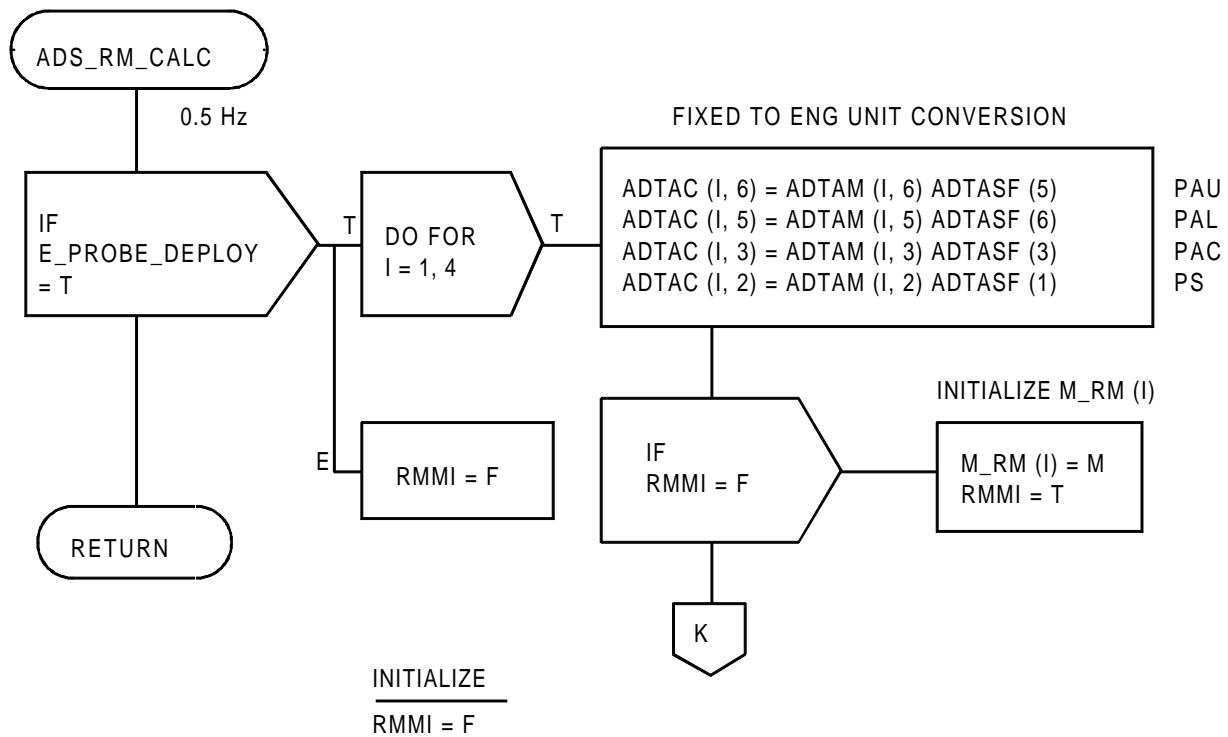


FIGURE 5.39-16.(1) ADS_RM_CALC Functional Module (Sheet 1 of 2)

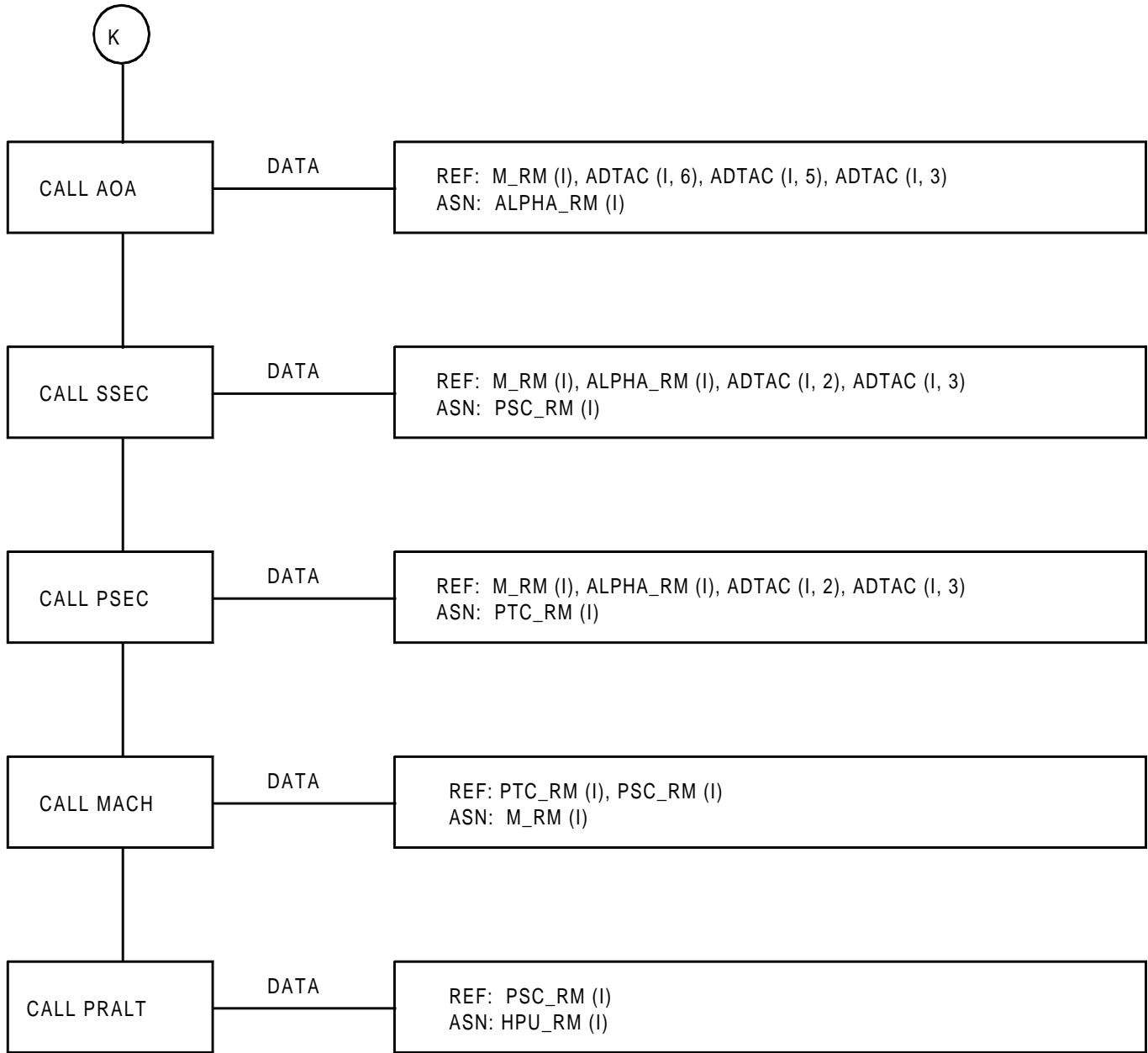


FIGURE 5.39-16.(2) ADS_RM_CALC Functional Module (Sheet 2 of 2)

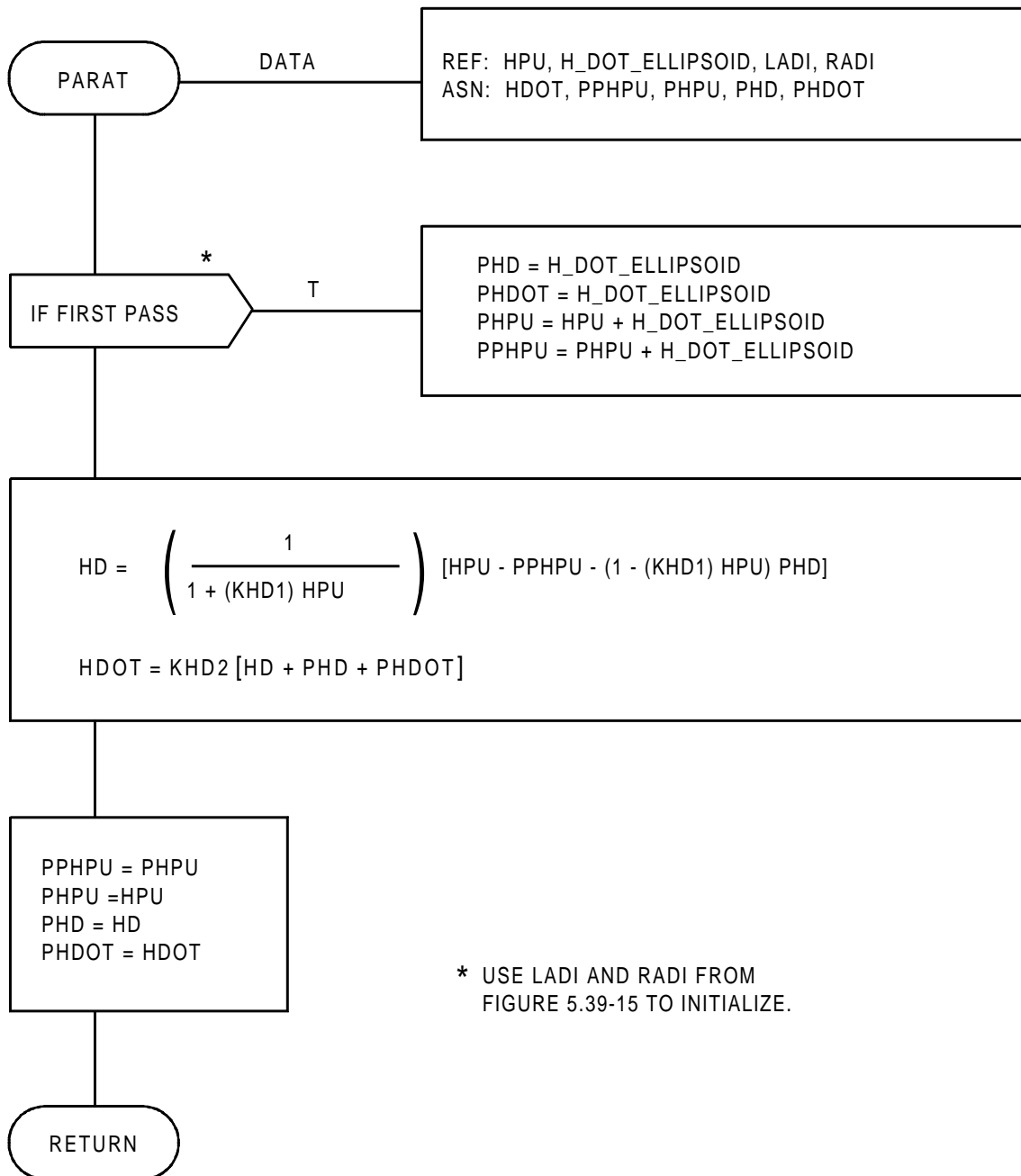


FIGURE 5.39-17. PARAT Common Module

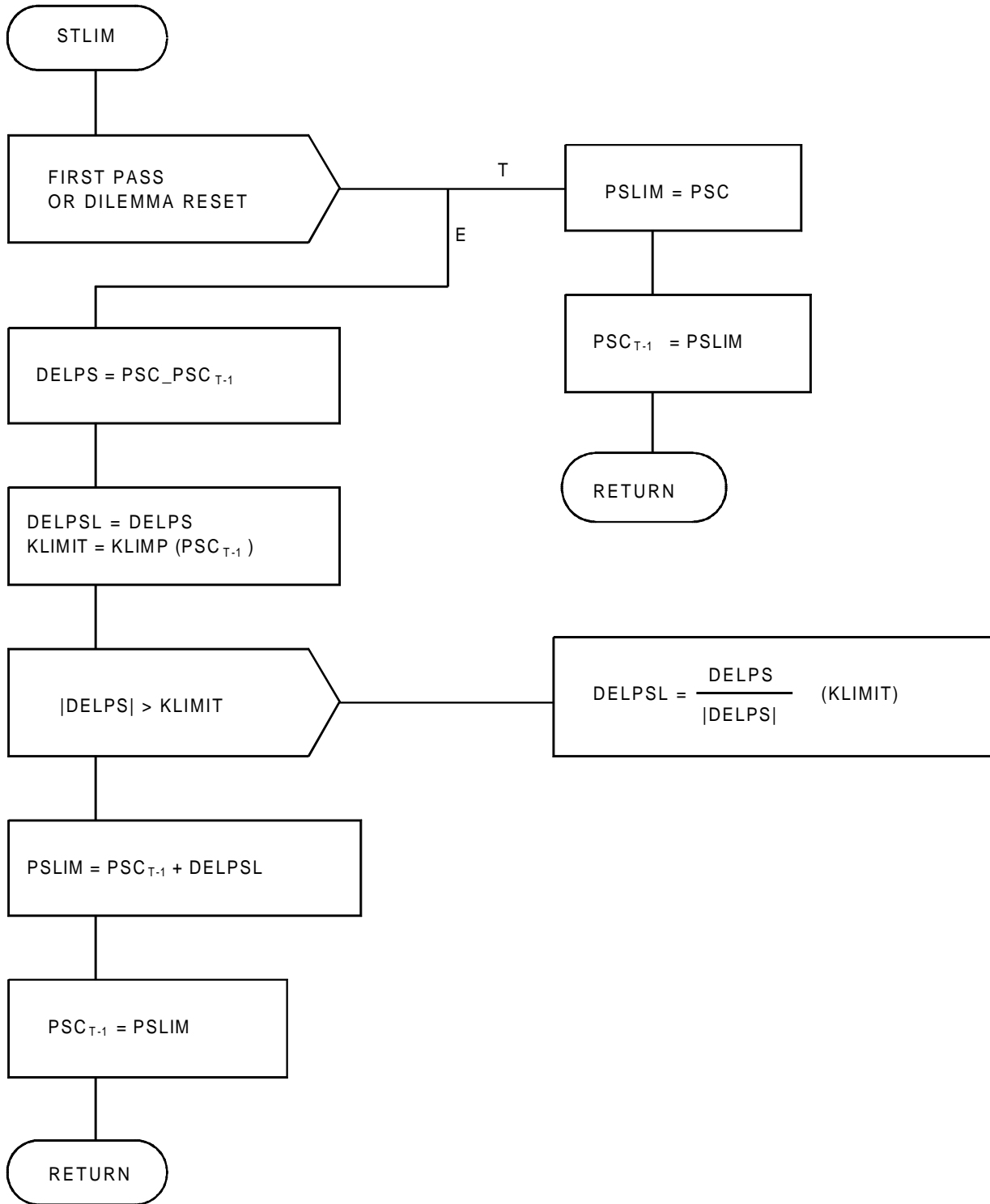


FIGURE 5.39-18. STLIM Module

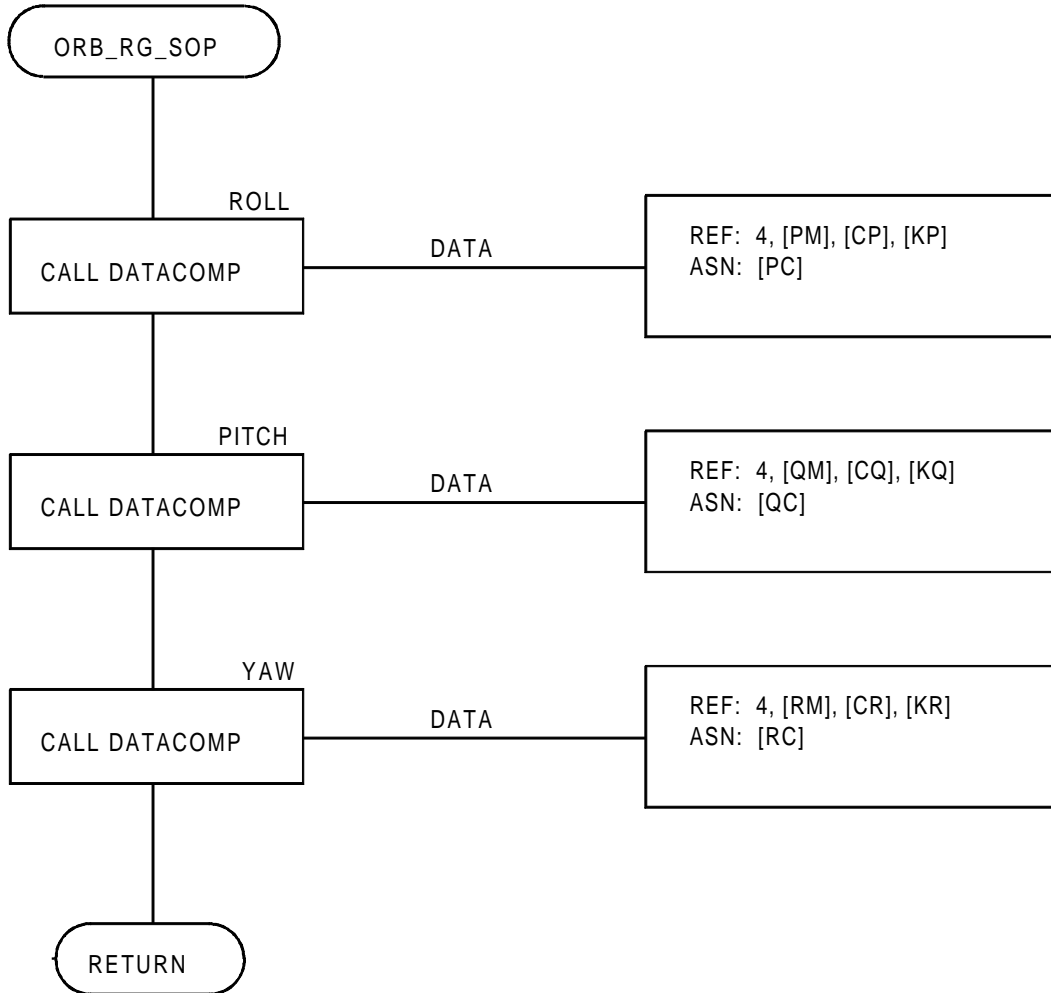


FIGURE 5.40-1. ORB_RG_SOP Functional Module

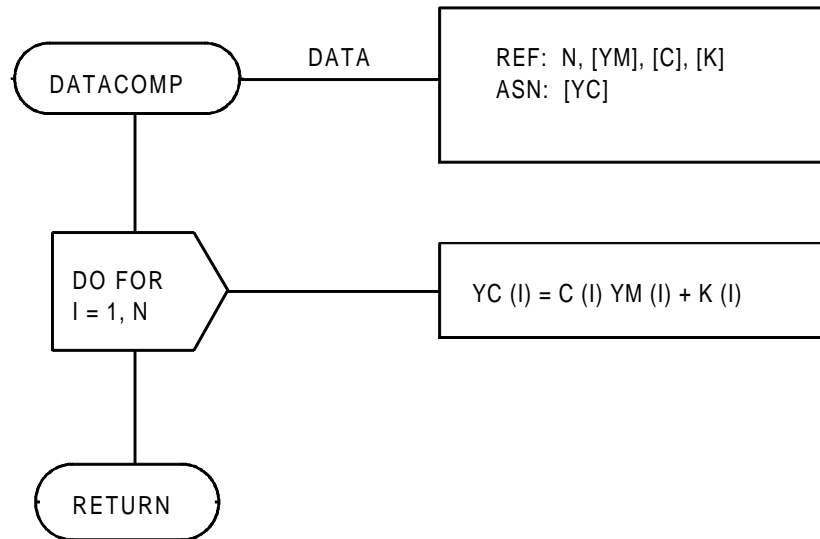


FIGURE 5.40-2. DATACOMP Common Module

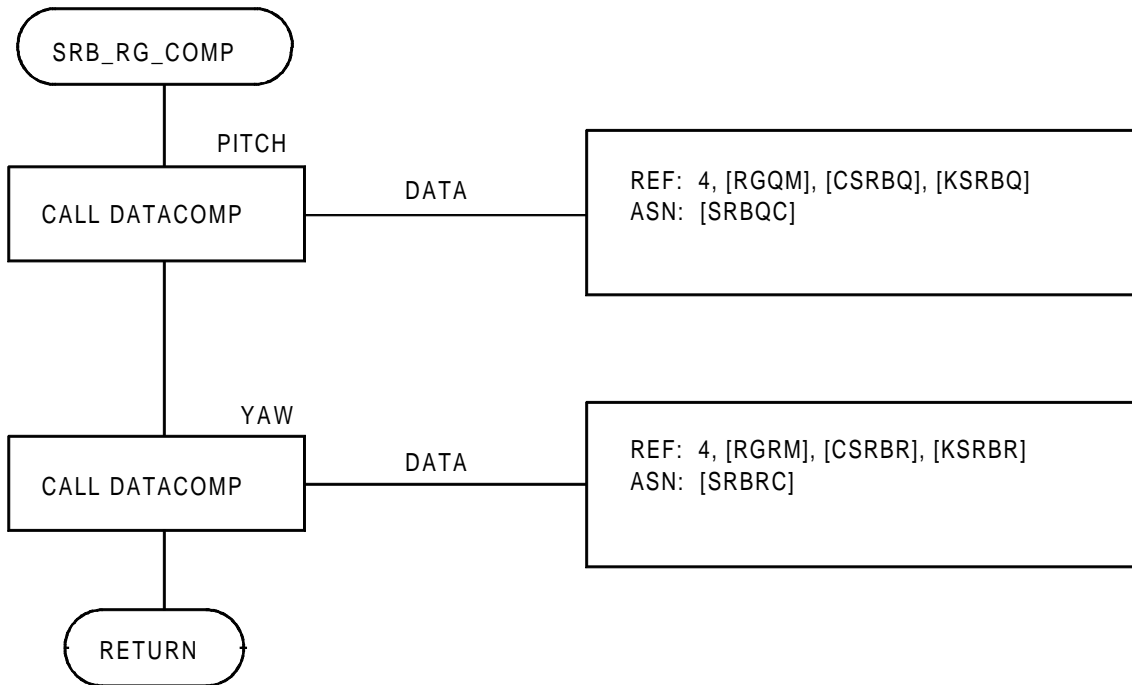


FIGURE 5.41-1. SRB_RG_COMP Functional Module

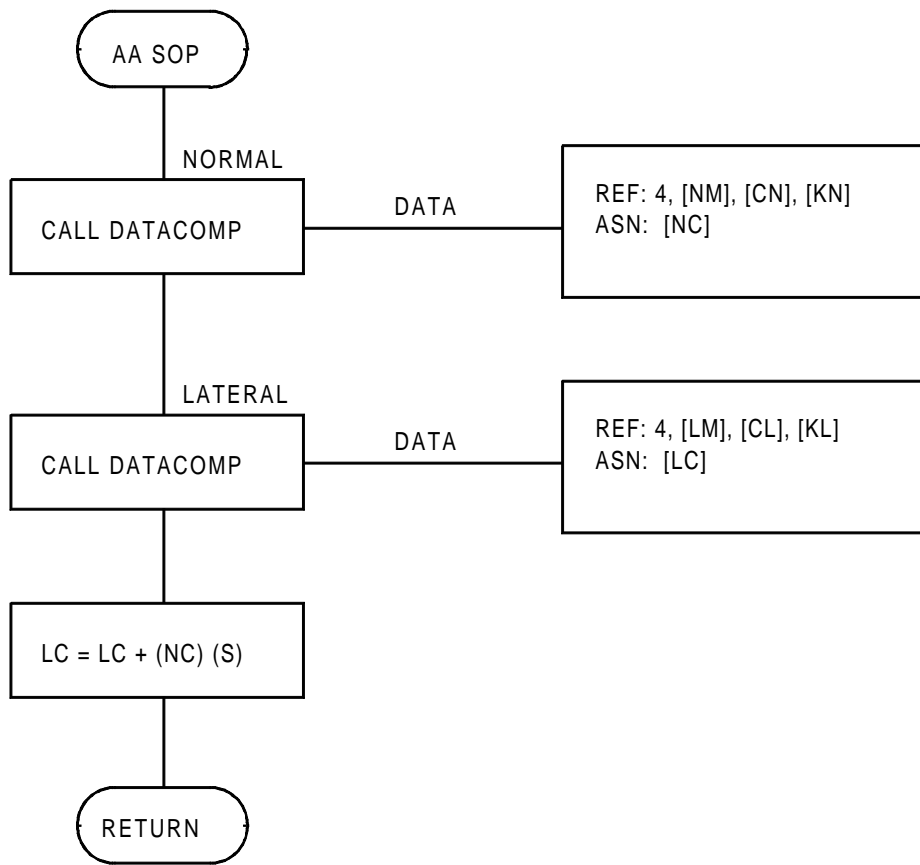


FIGURE 5.42-1. AA SOP Functional Module

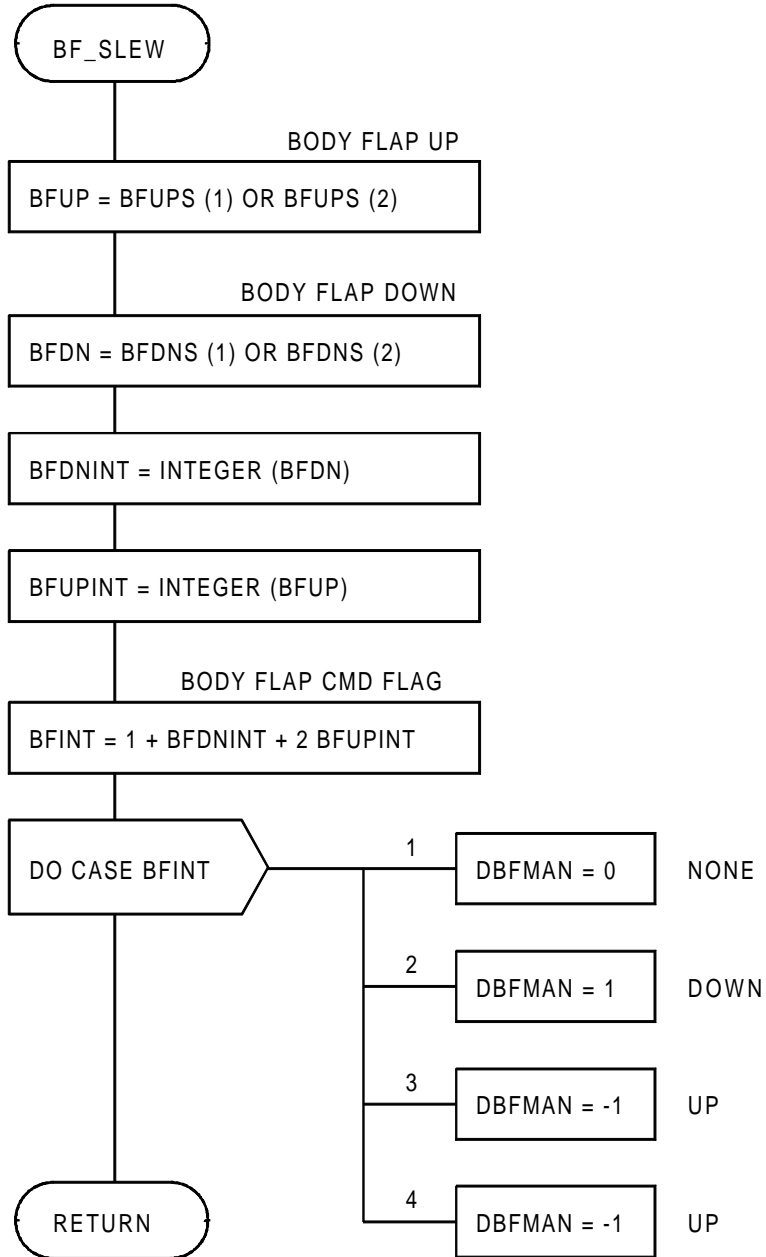


FIGURE 5.51-1. BF_SLEW Functional Module

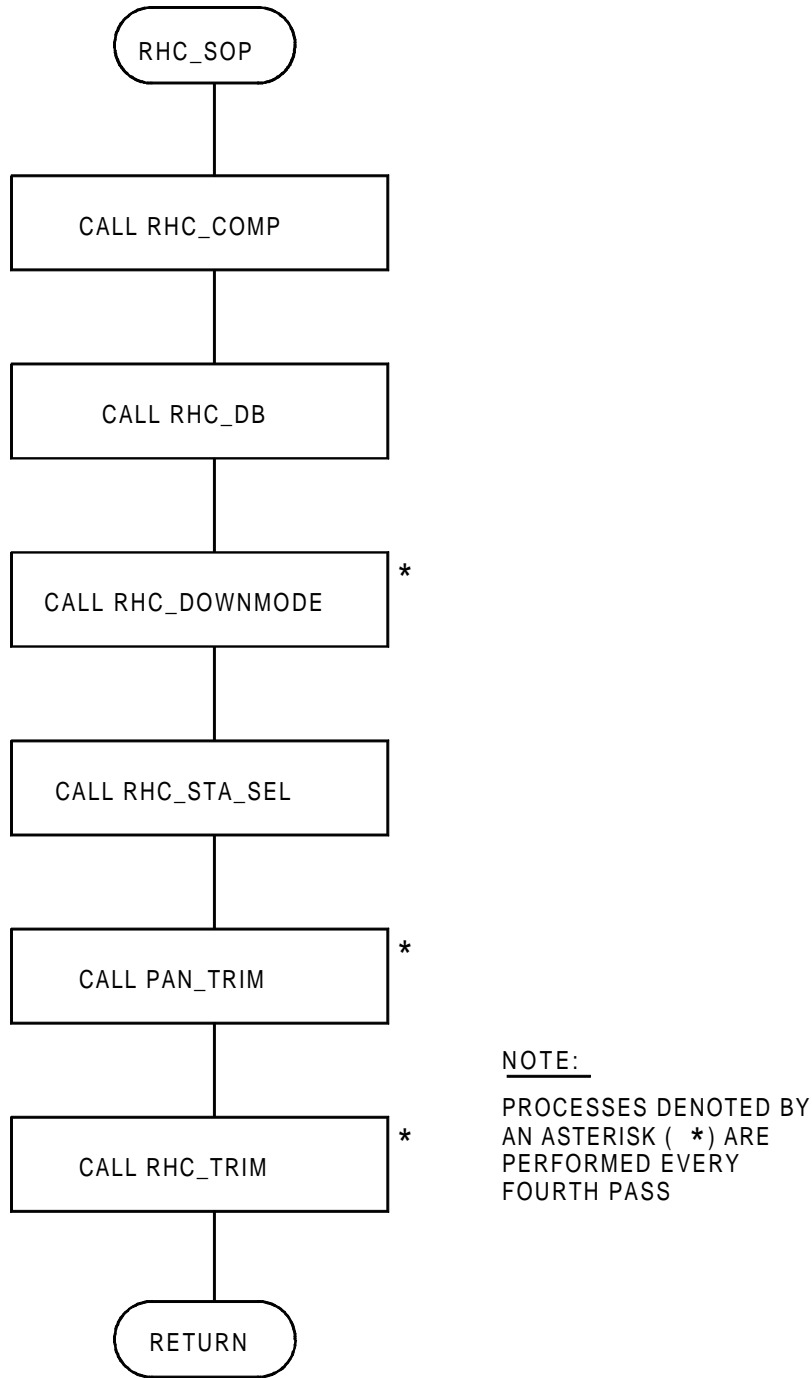


FIGURE 5.53-1. RHC_SOP Functional Module

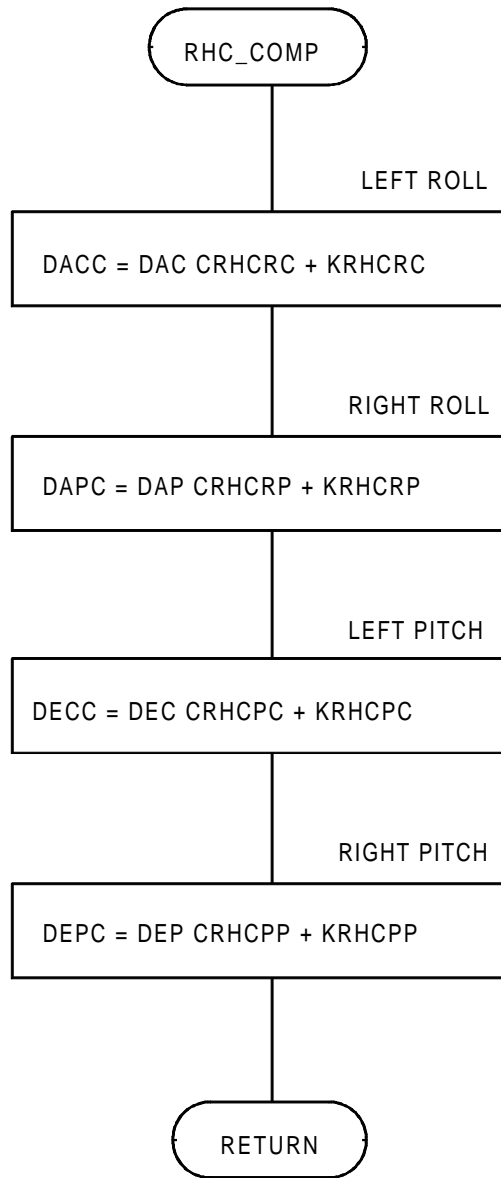


FIGURE 5.53-2. RHC_COMP Functional Module

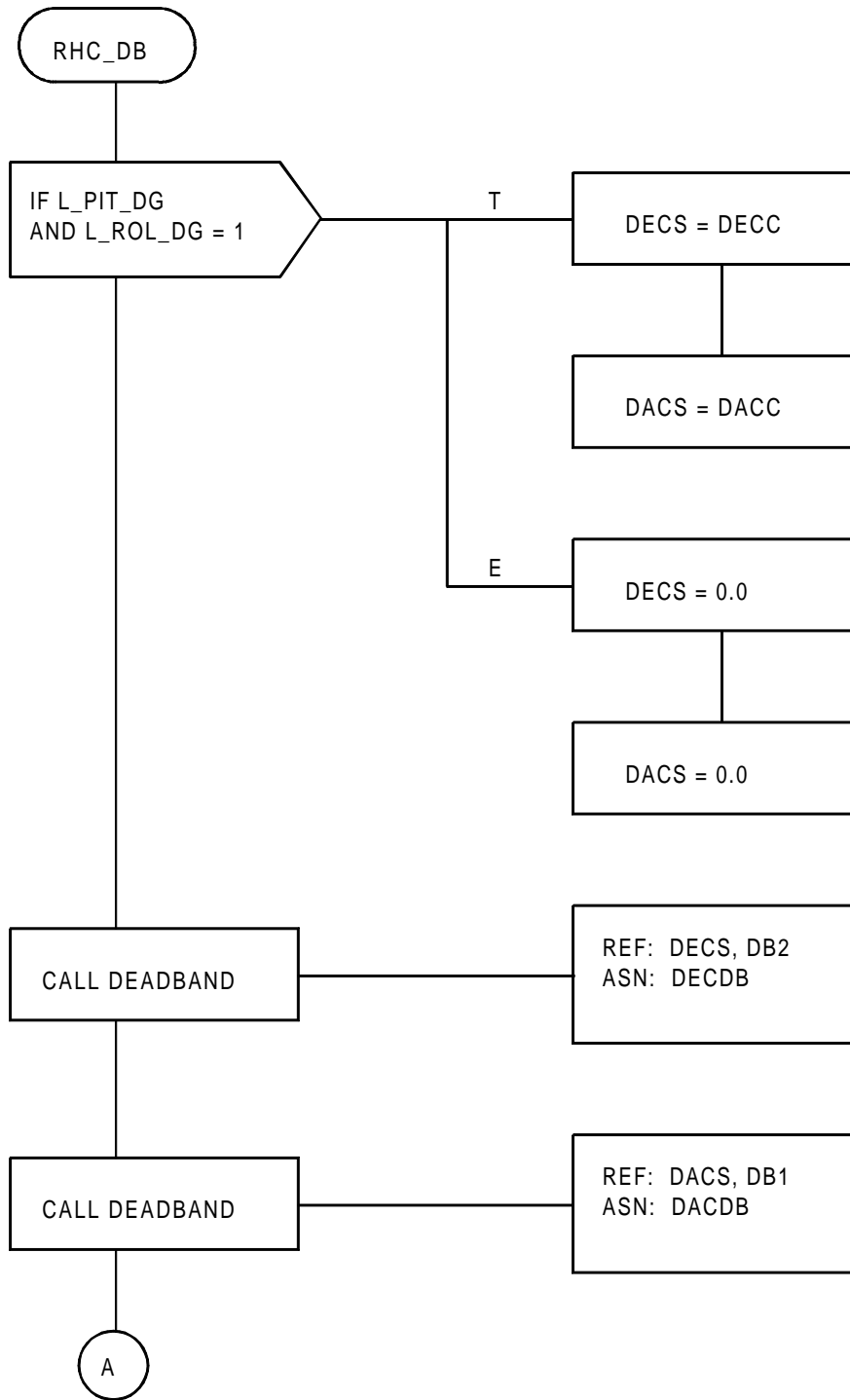


FIGURE 5.53-3.(1) RHC_DB Functional Module (Sheet 1 of 2)

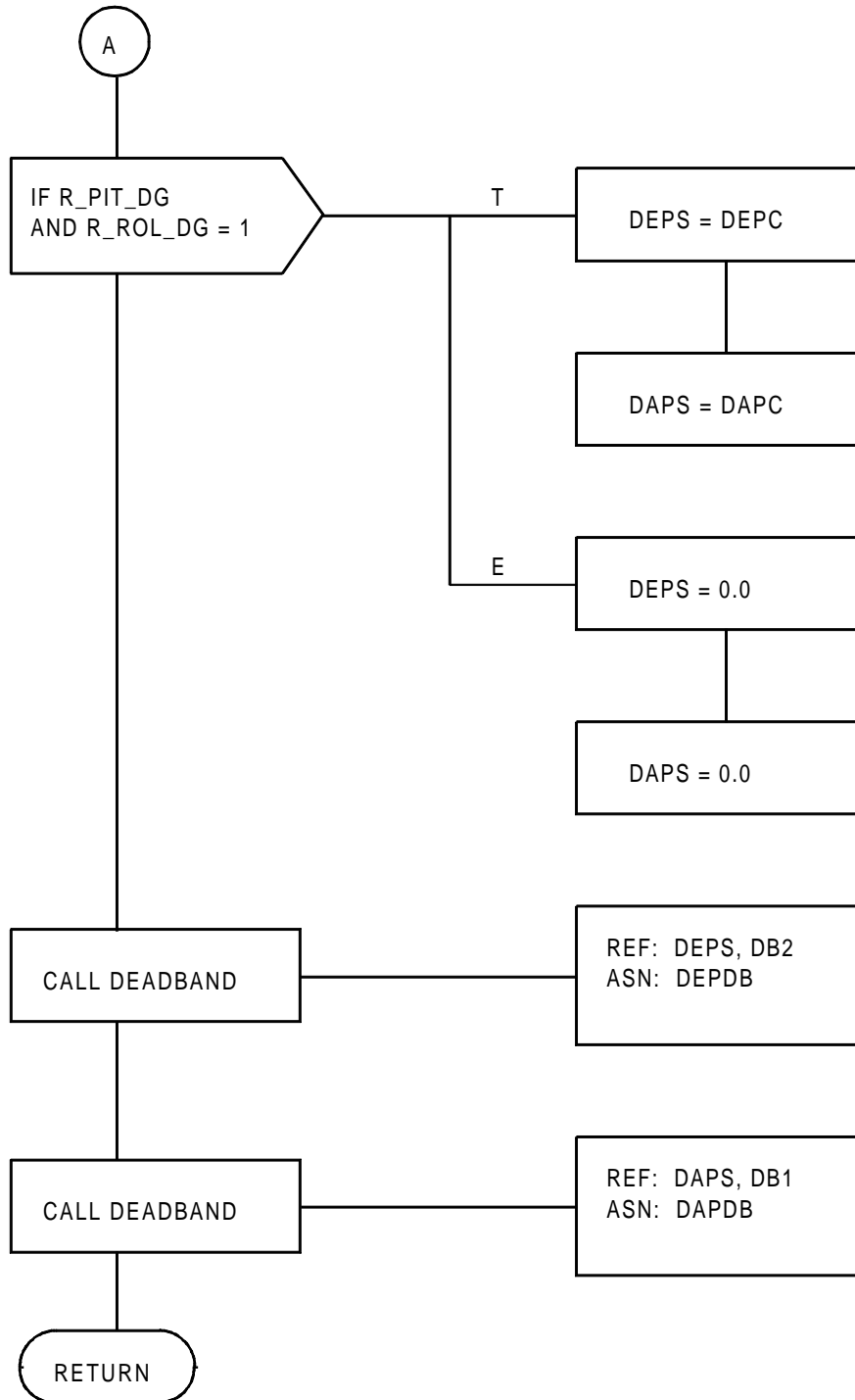


FIGURE 5.53-3.(2) RHC_DB Functional Module (Sheet 2 of 2)

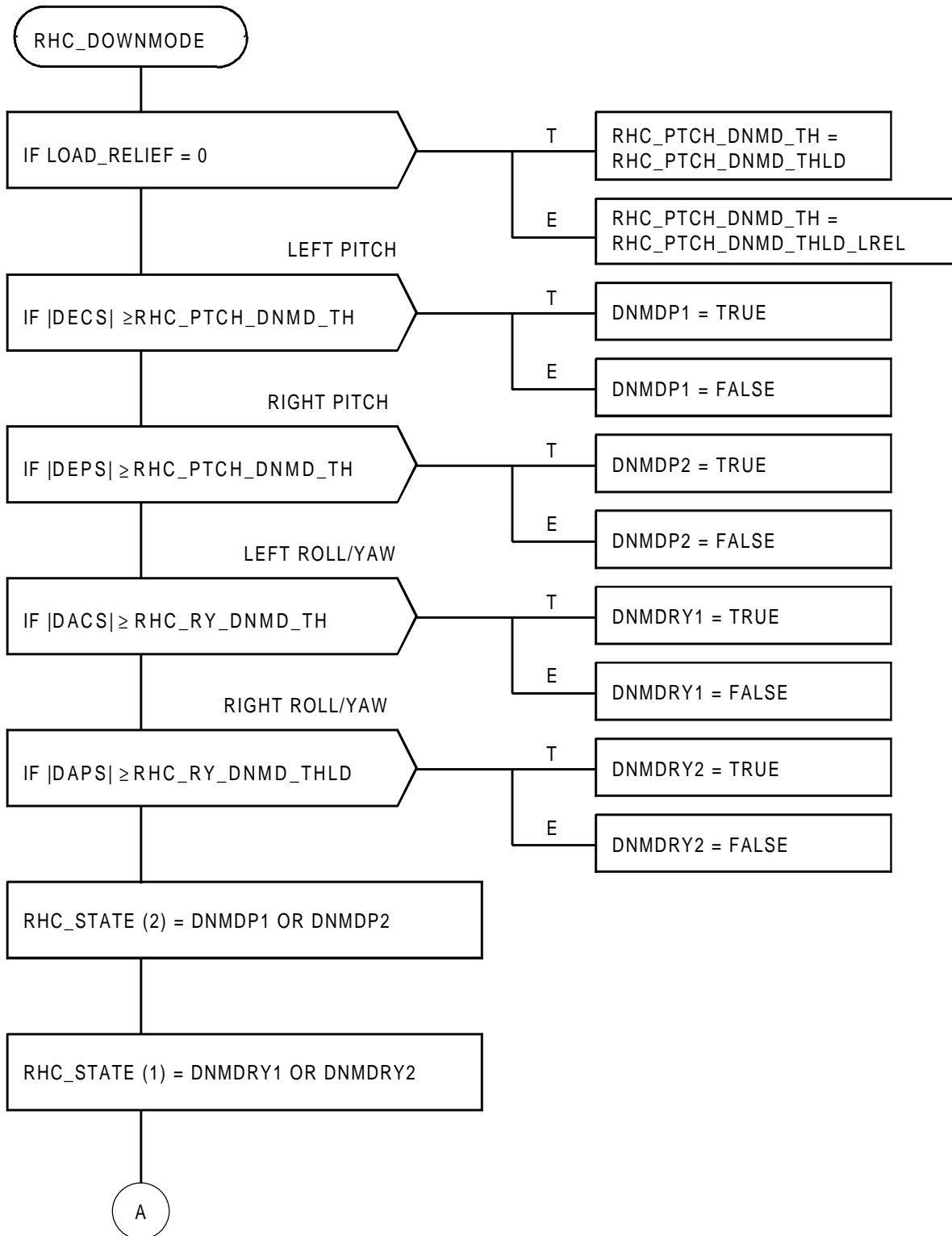


FIGURE 5.53-4.(1) RHC_DOWNMODE Functional Module (Sheet 1 of 2)

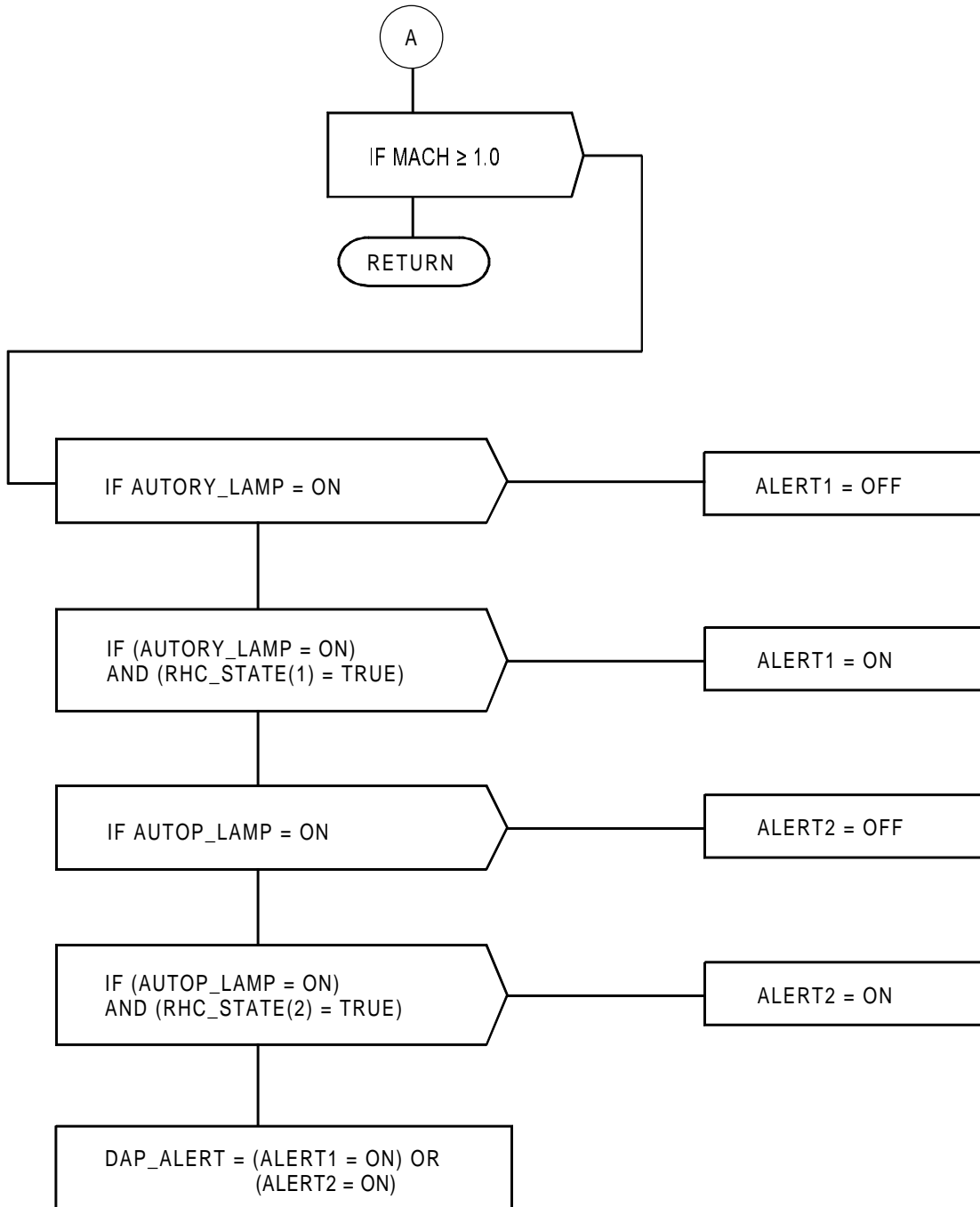


FIGURE 5.53-4.(2) RHC_DOWNMODE Functional Module (Sheet 2 of 2)

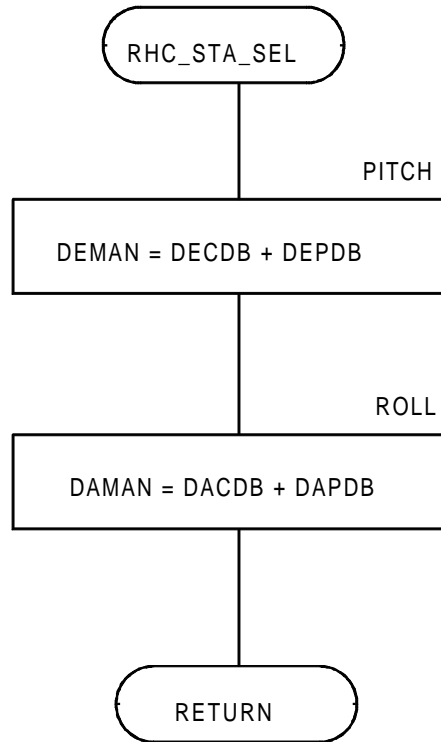


FIGURE 5.53-5. RHC_STA_SEL Functional Module

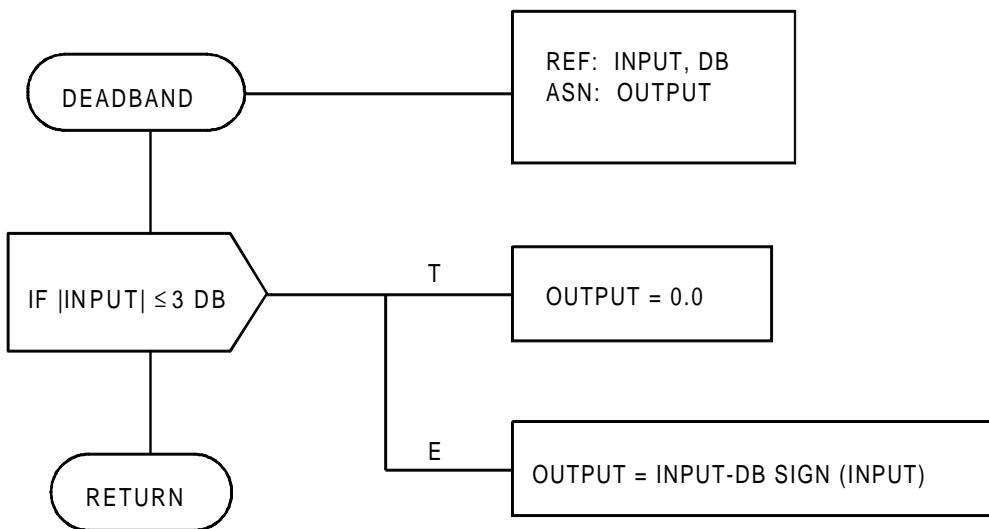


FIGURE 5.53-6. Deadband Common Module

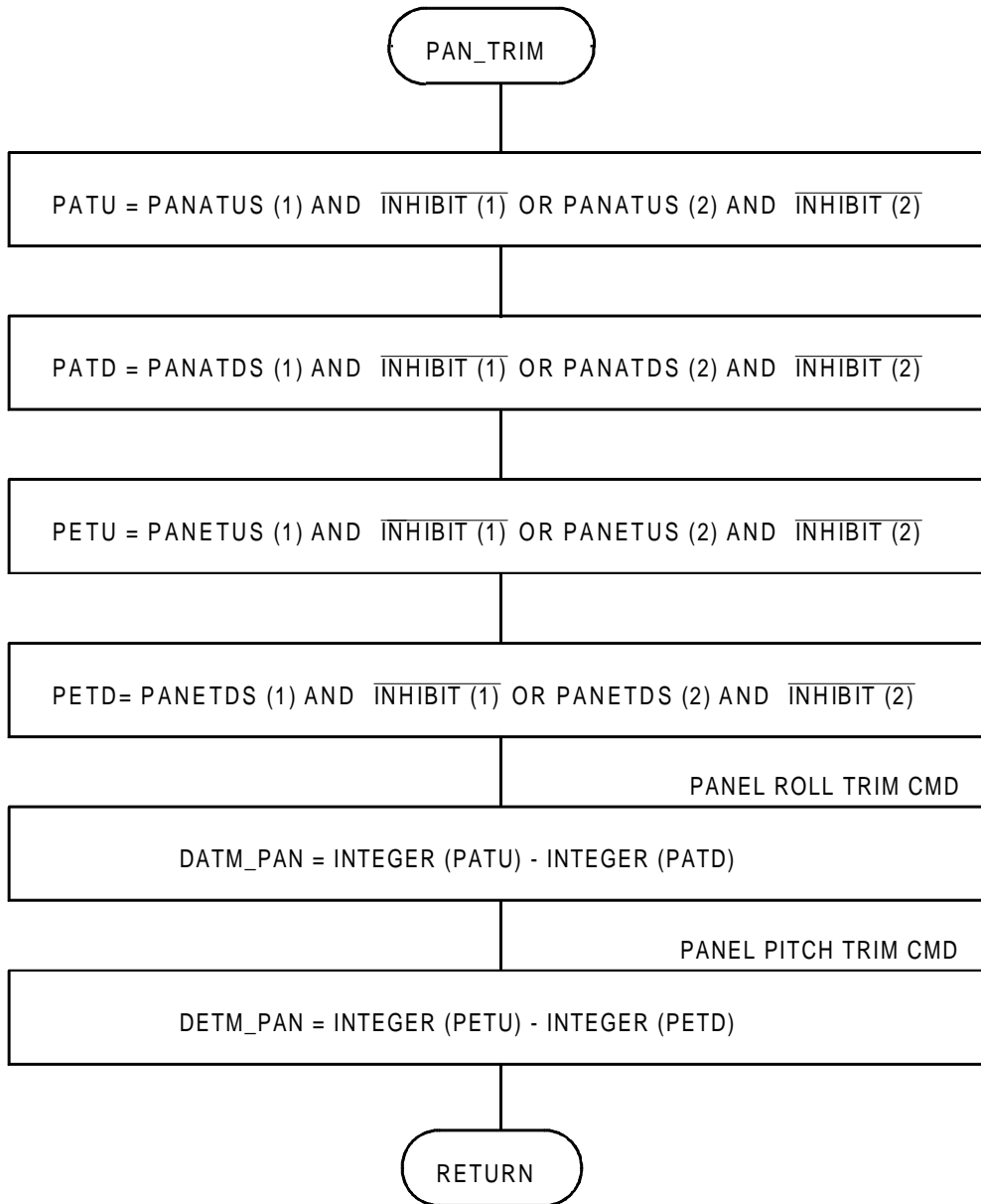


FIGURE 5.53-7. PAN_TRIM Functional Module

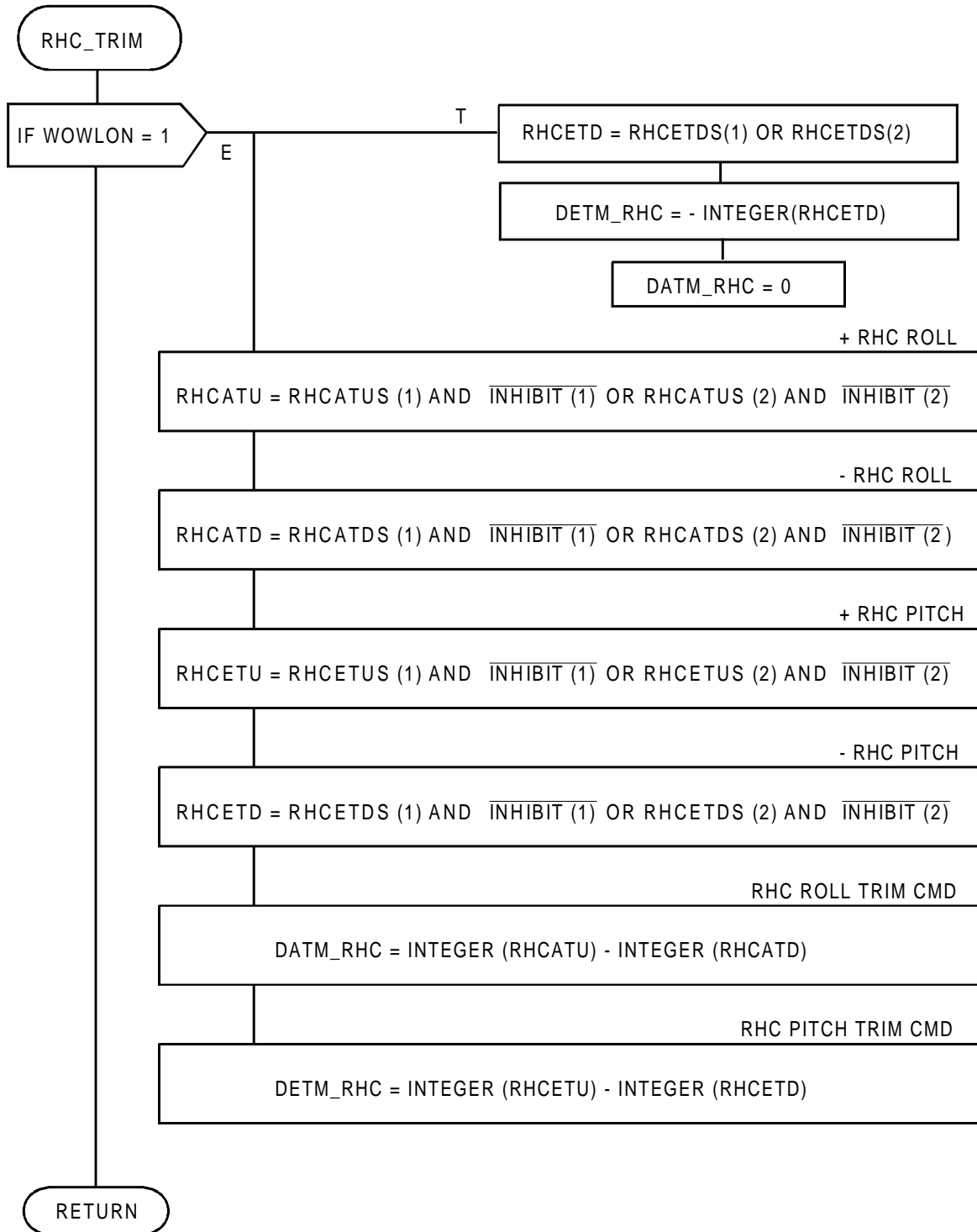


FIGURE 5.53-8. RHC_TRIM Functional Module

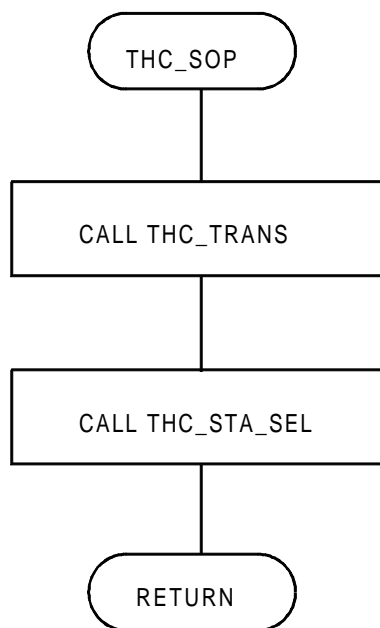


FIGURE 5.54-1. THC_SOP Functional Module

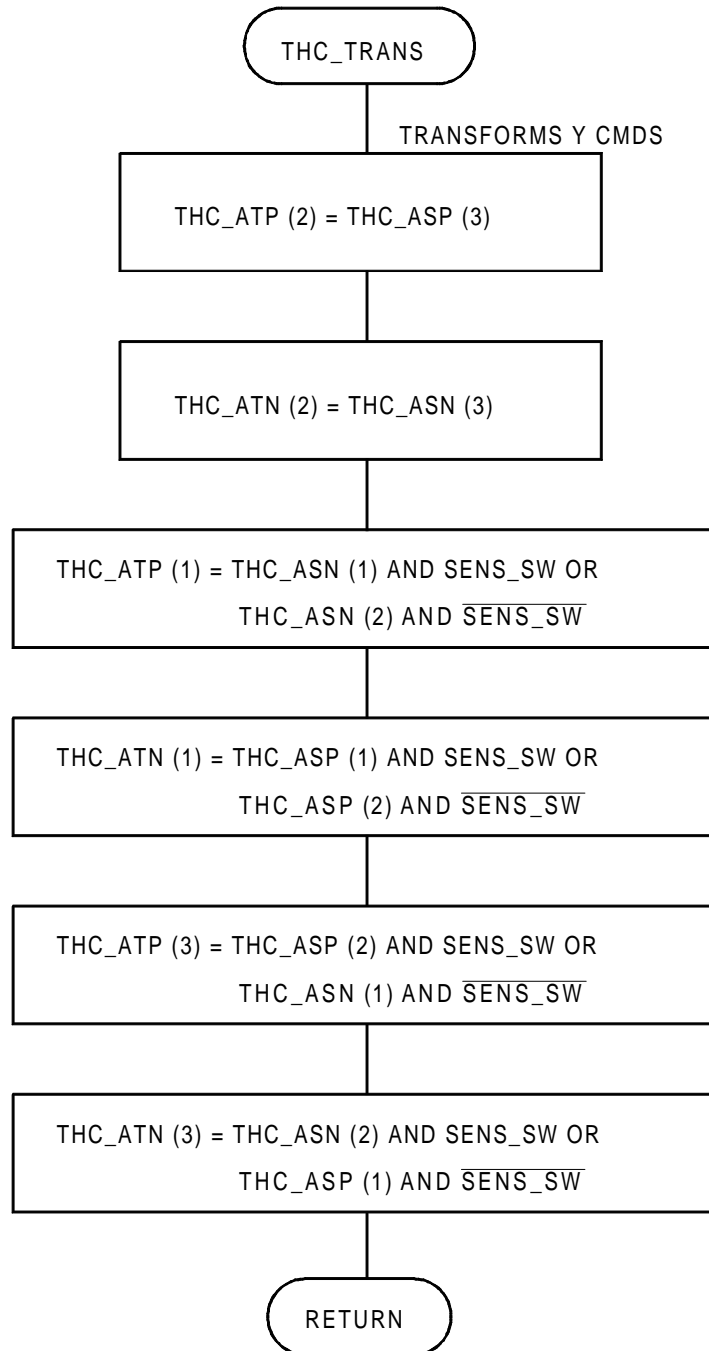


FIGURE 5.54-2. THC_TRANS Functional Module

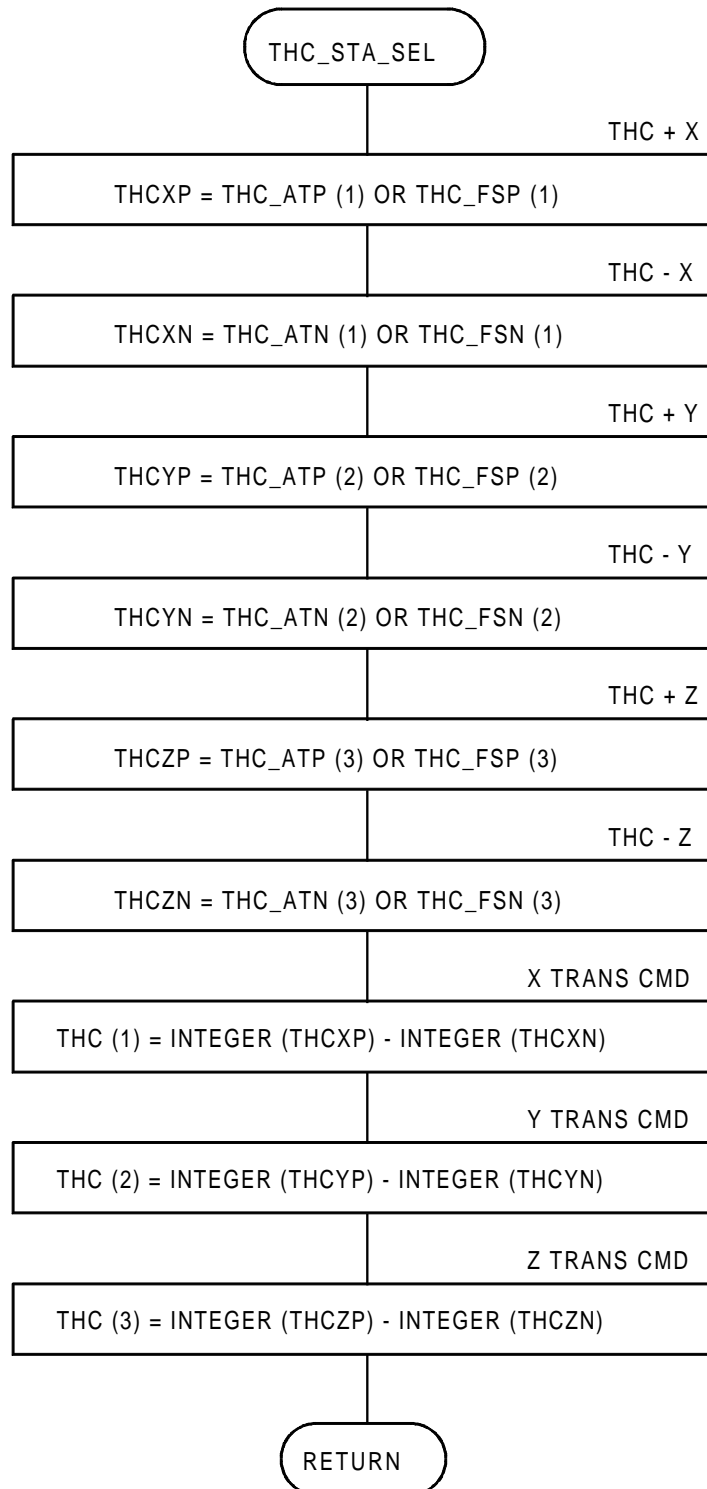


FIGURE 5.54-3. THC_STA_SEL Functional Mode

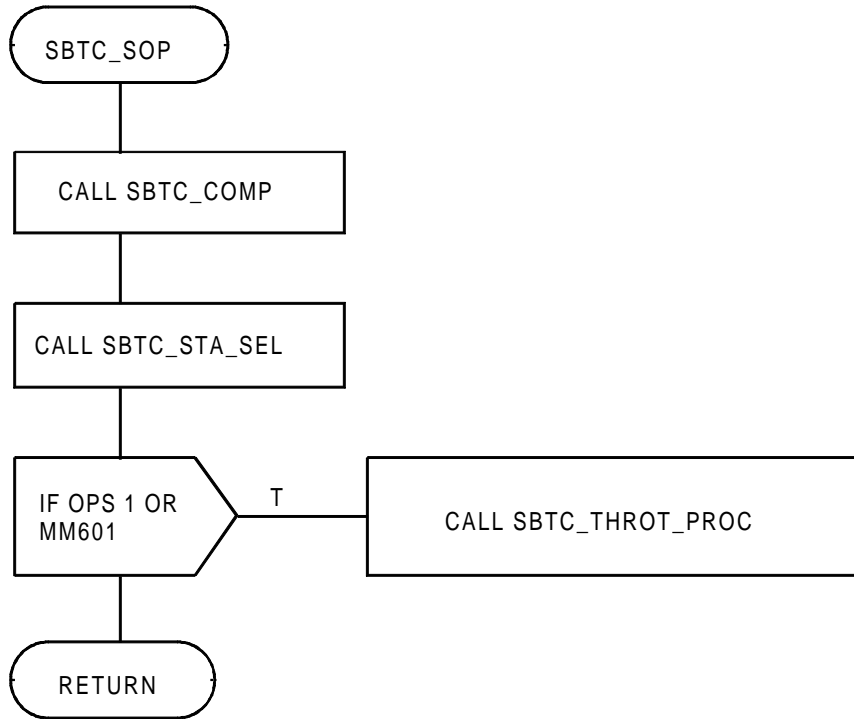


FIGURE 5.55-1. SBTC_SOP Functional Module

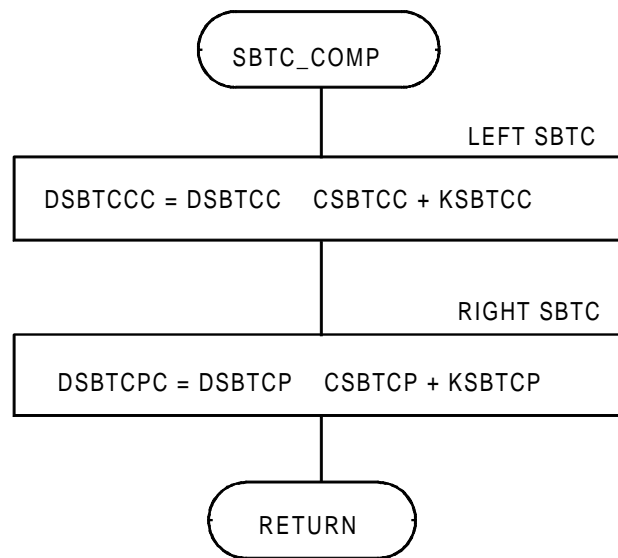


FIGURE 5.55-2. SBTC_COMP Functional Module

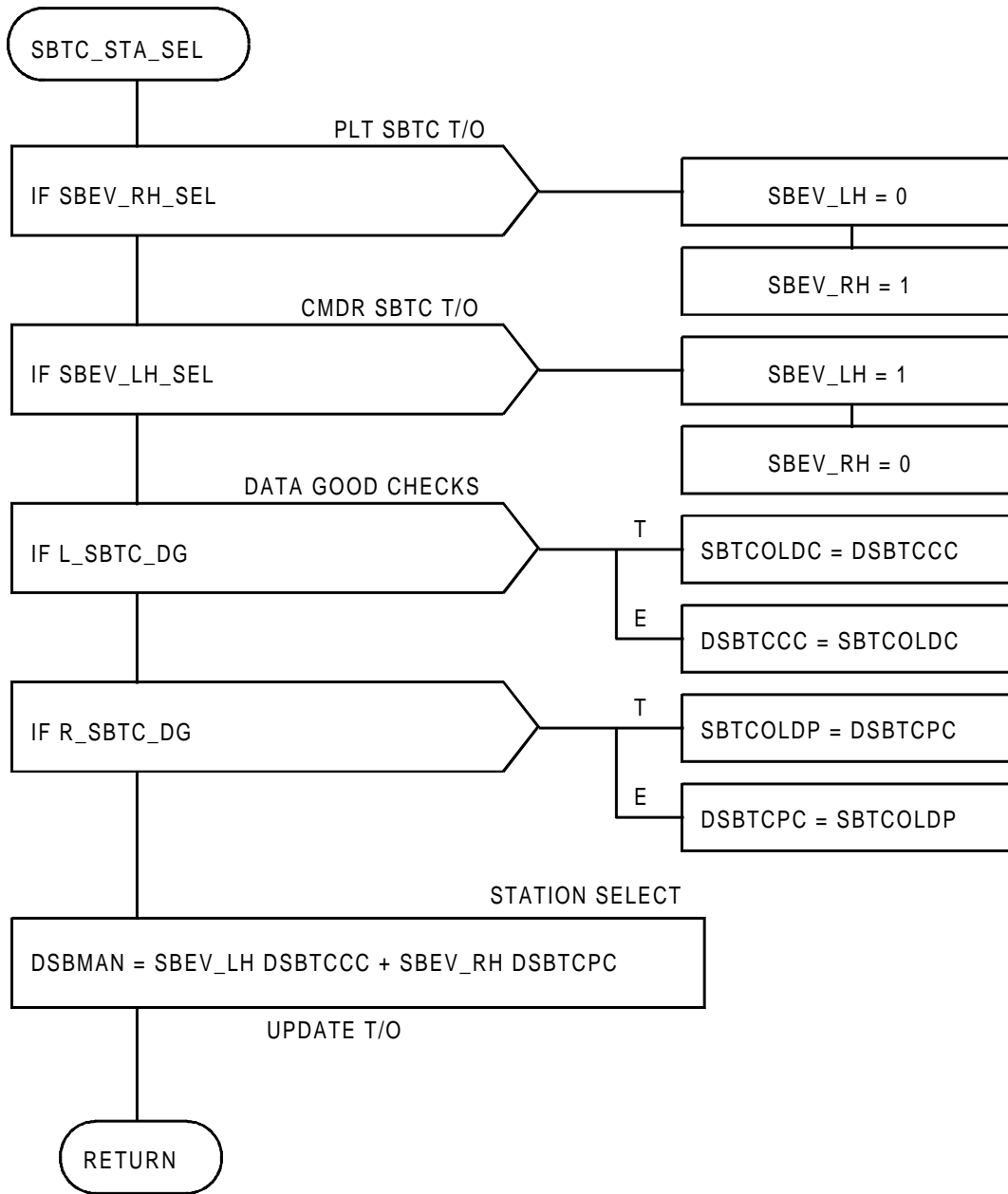


FIGURE 5.55-3. SBTC_STA_SEL Functional Module

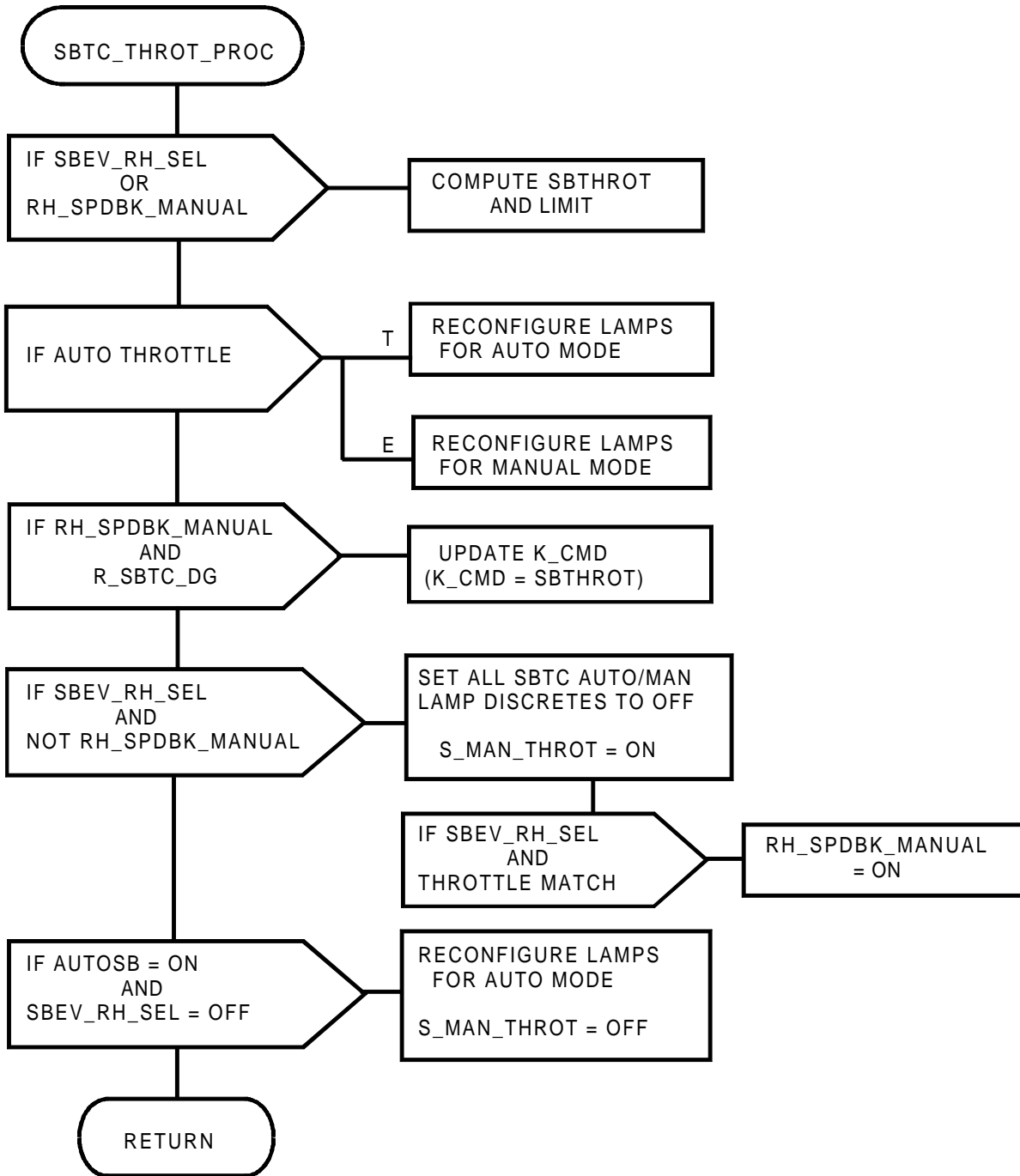


FIGURE 5.55-4. SBTC_THROT_PROC Functional Module

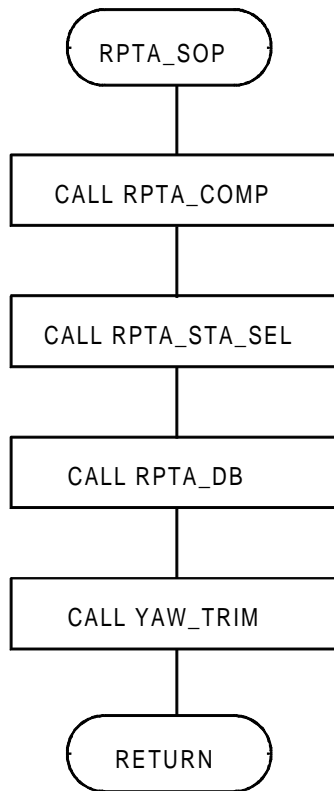


FIGURE 5.56-1. RPTA_SOP Functional Module

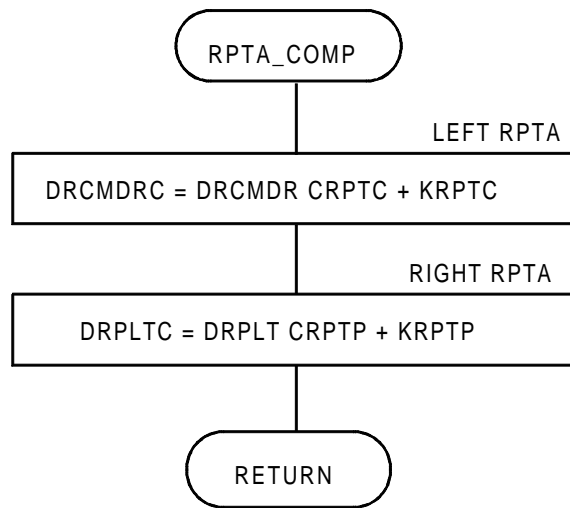


FIGURE 5.56-2. RPTA_COMP Functional Module

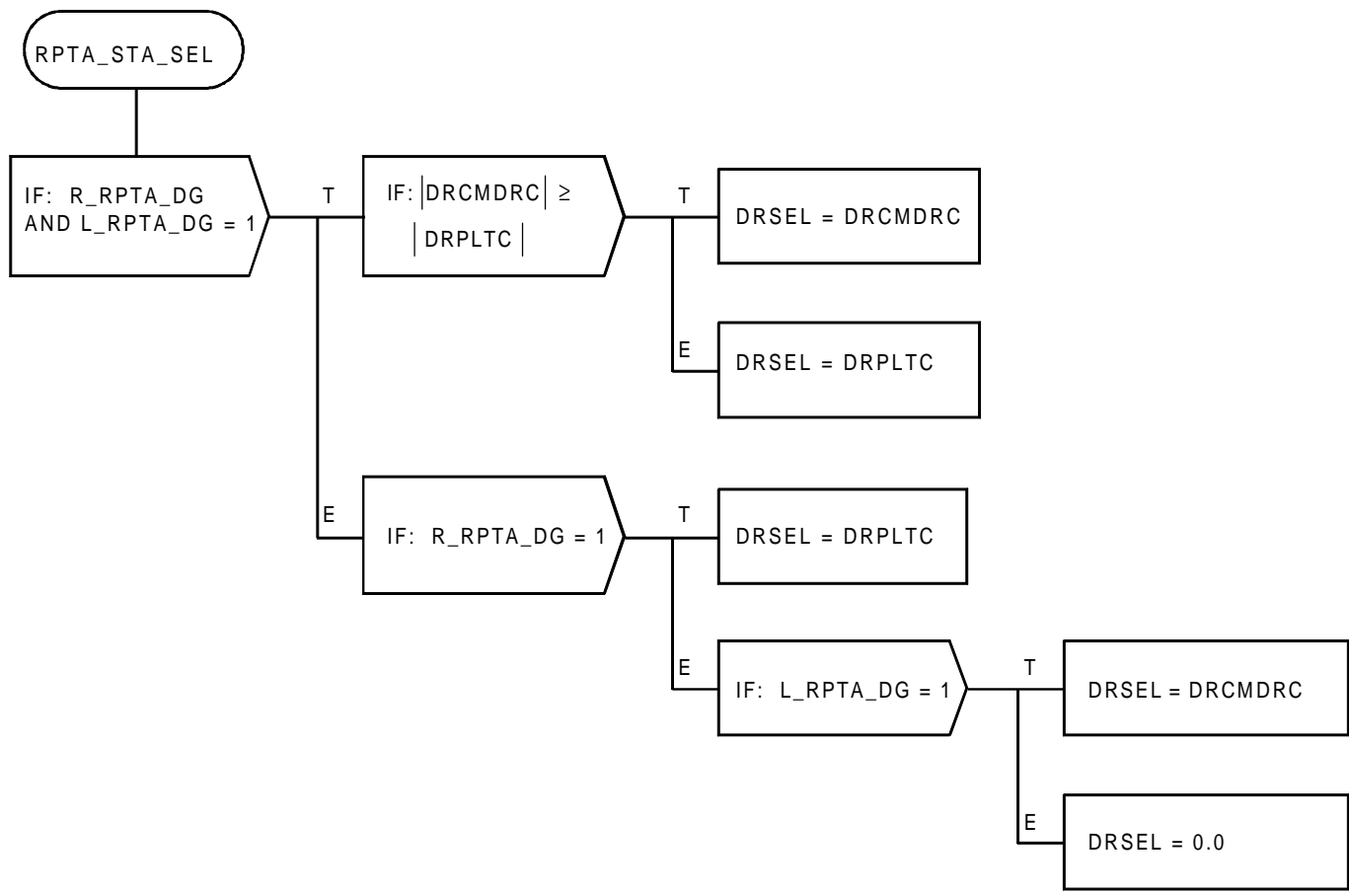


FIGURE 5.56-3. RPTA_STA_SEL Functional Module

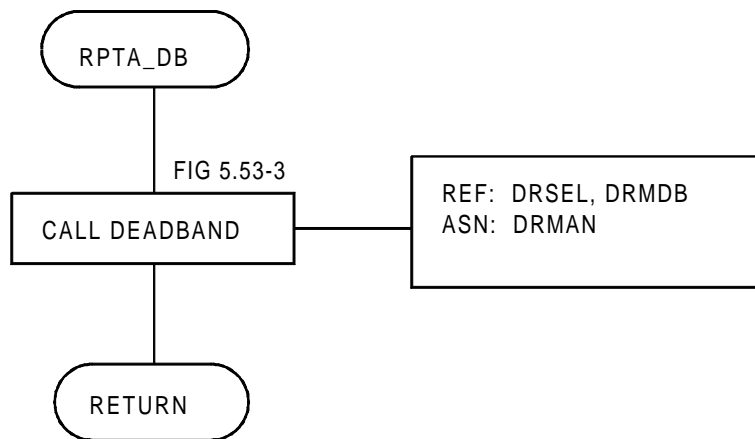


FIGURE 5.56-4. RPTA_DB Functional Module

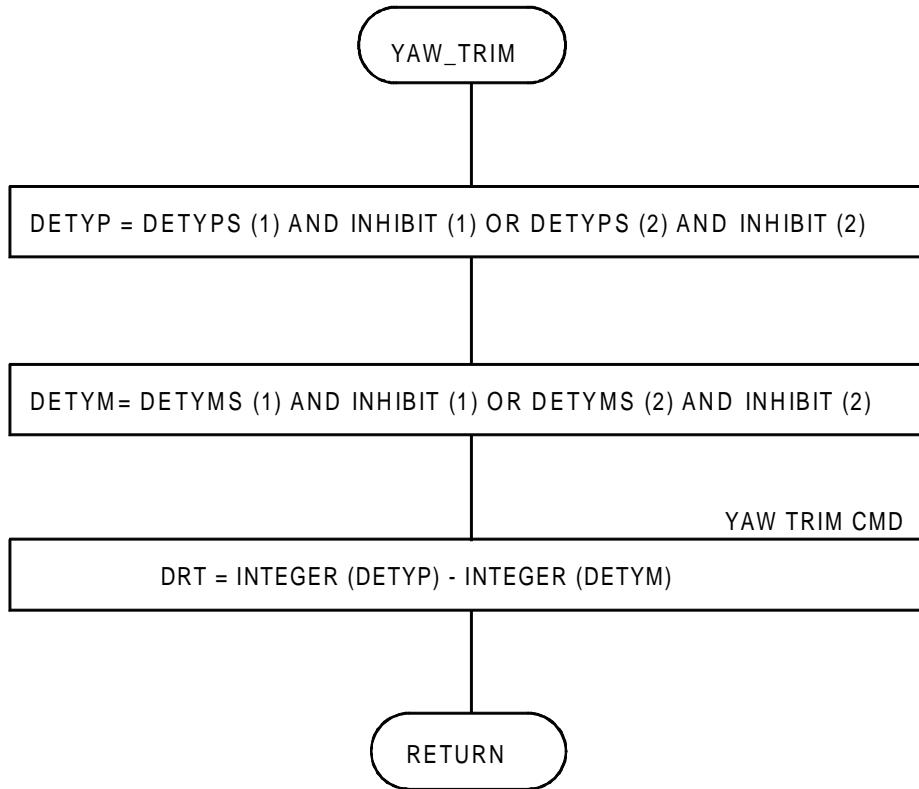


FIGURE 5.56-5. YAW_TRIM Functional Module

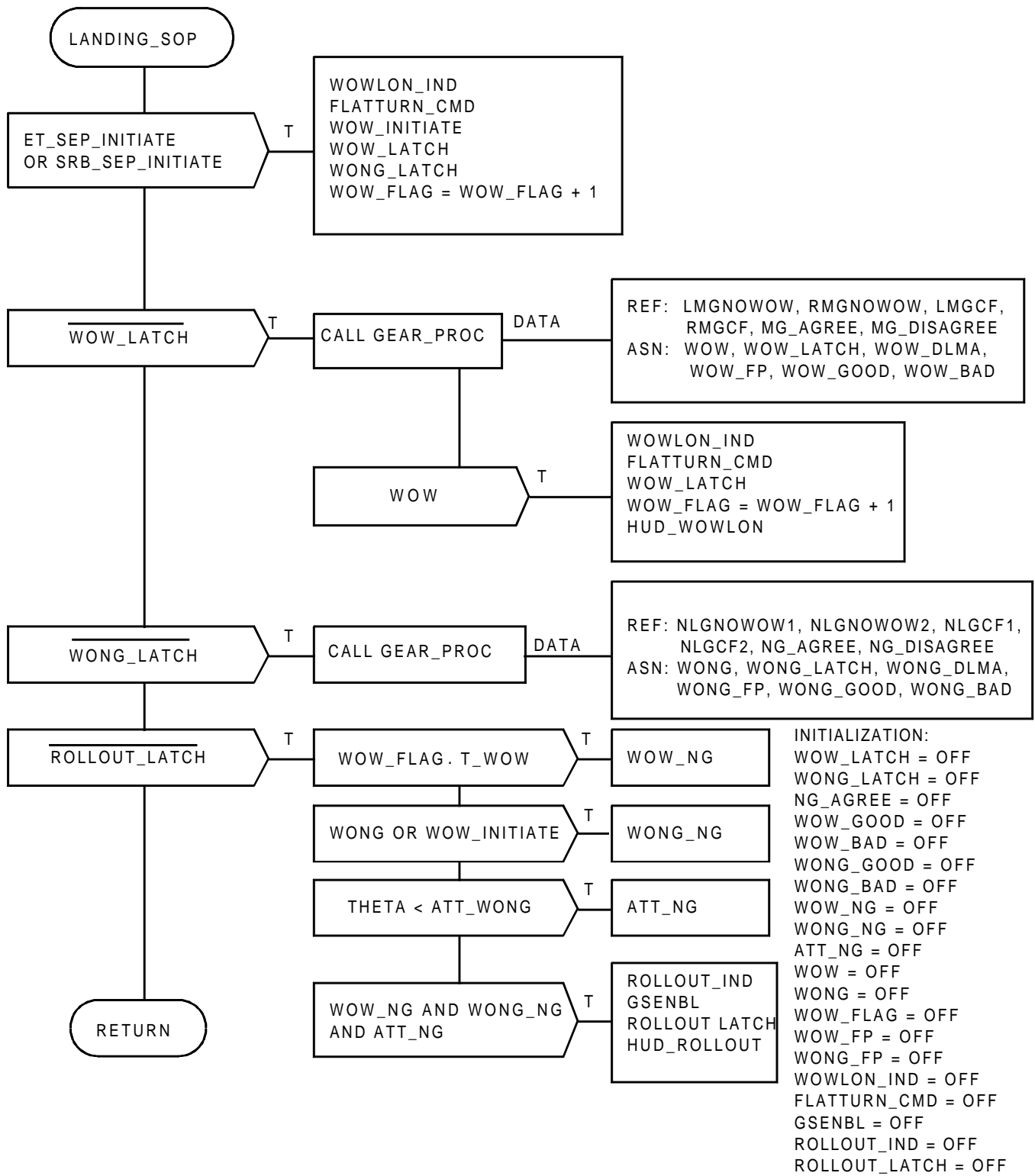


FIGURE 5.57-1. LANDING_SOP Functional Module

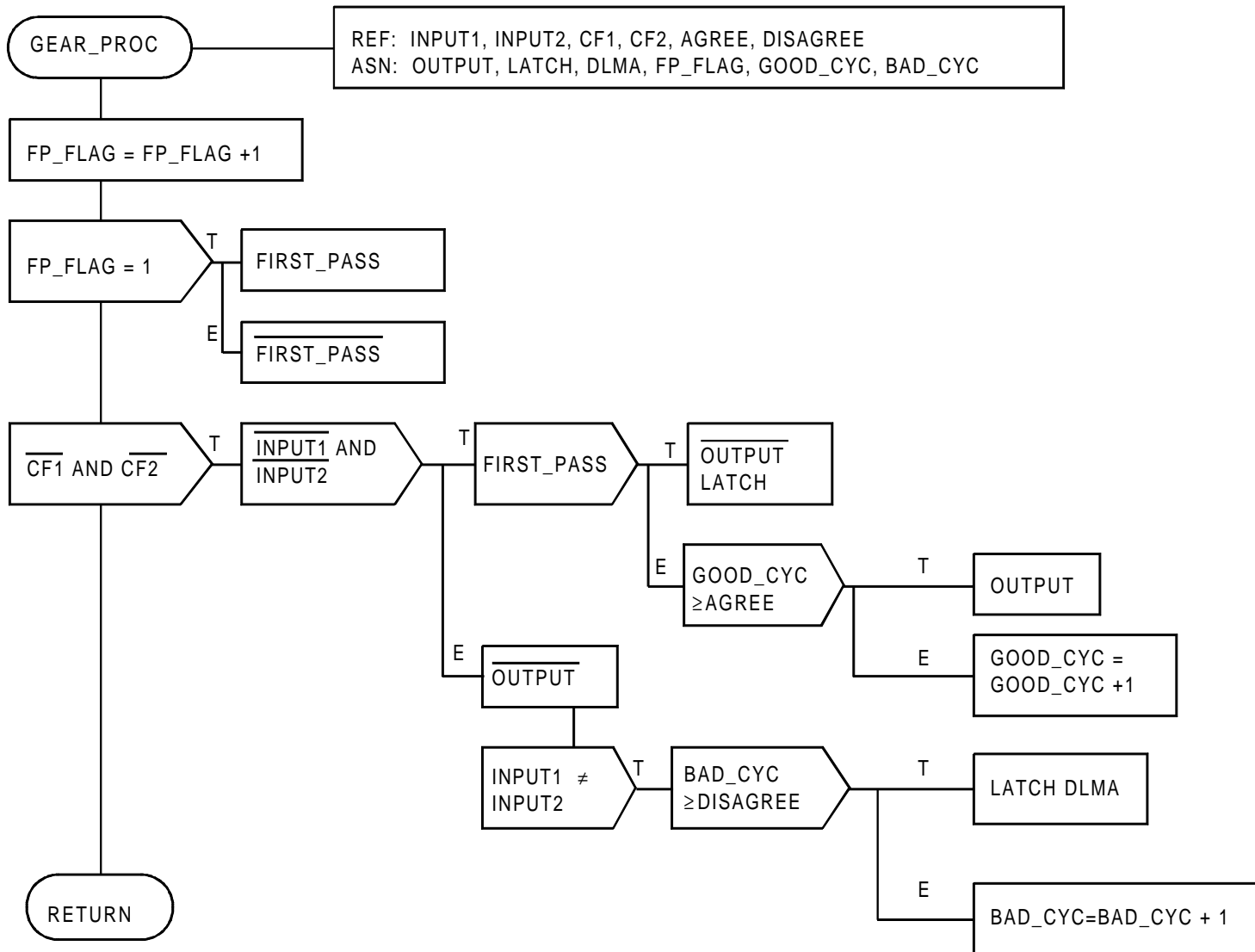


FIGURE 5.57-2. GEAR_PROC Common Module

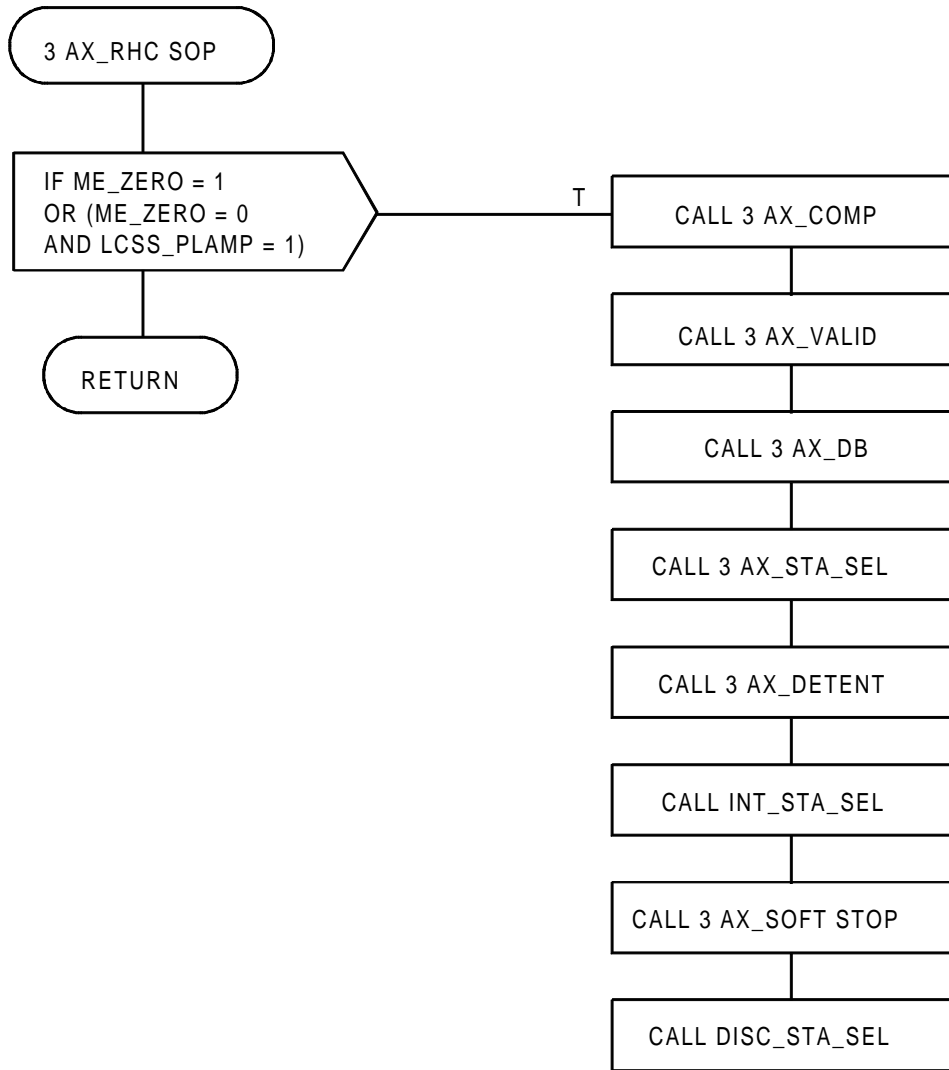


FIGURE 5.171-1. 3 AX_RHC SOP Functional Module

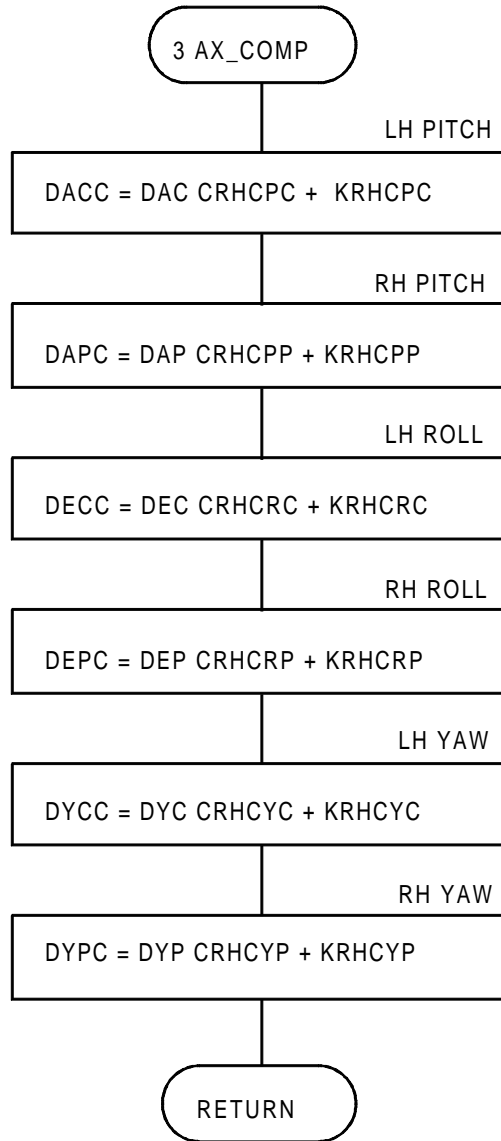


FIGURE 5.171-2. 3 AX_COMP Functional Module

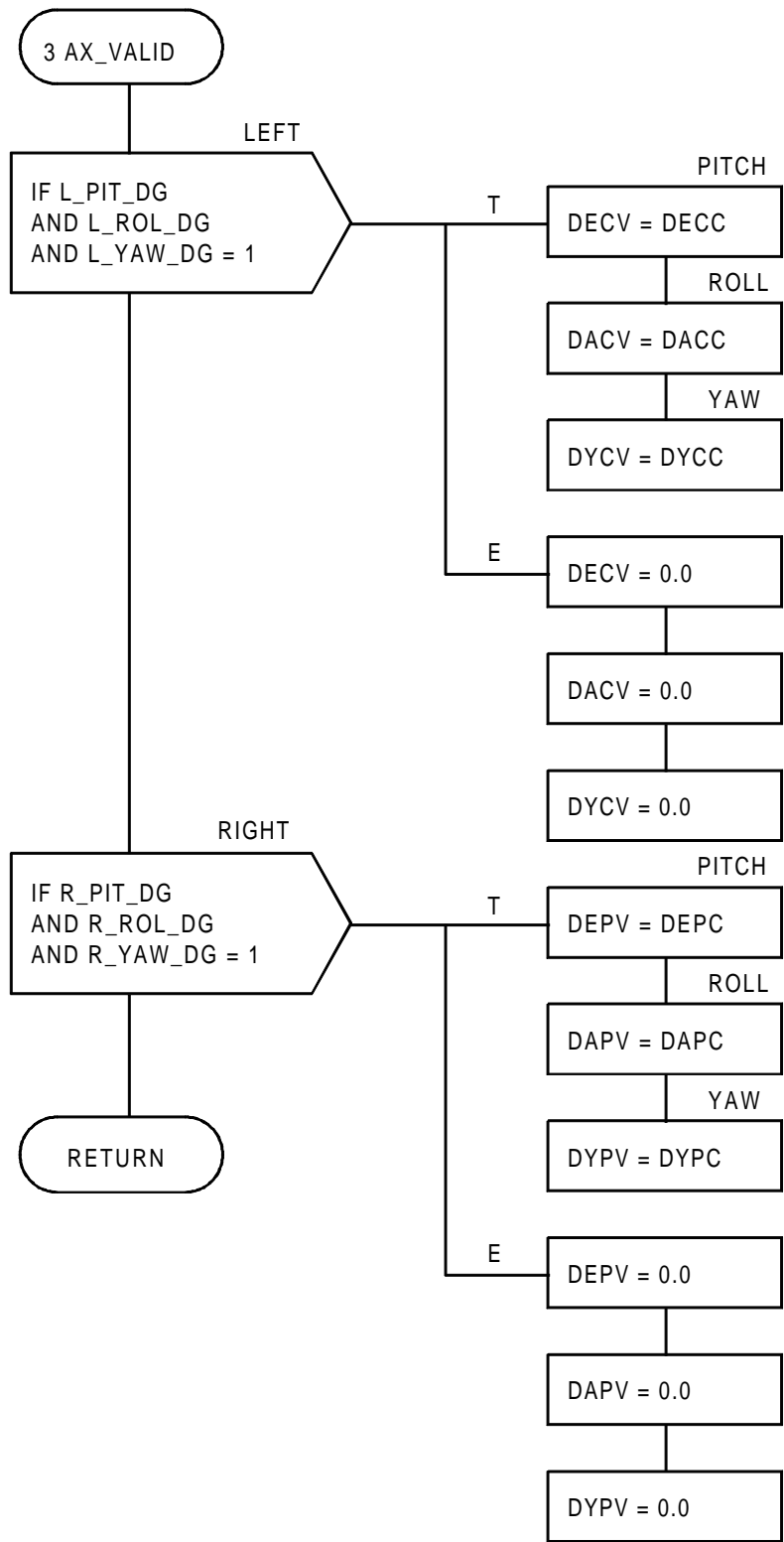


FIGURE 5.171-3. 3 AX_VALID Functional Module

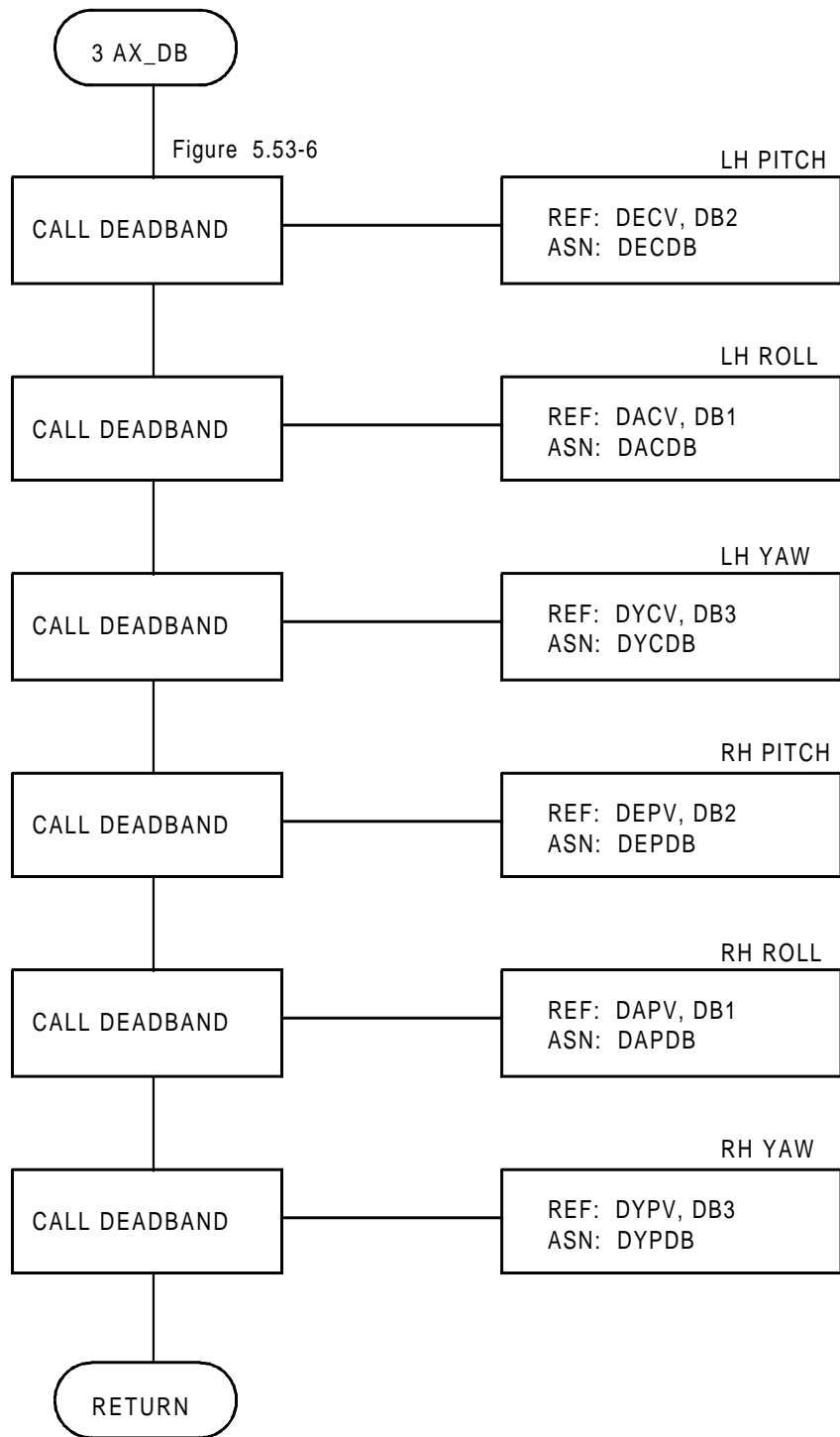


FIGURE 5.171-4. 3 AX_DB Functional Module

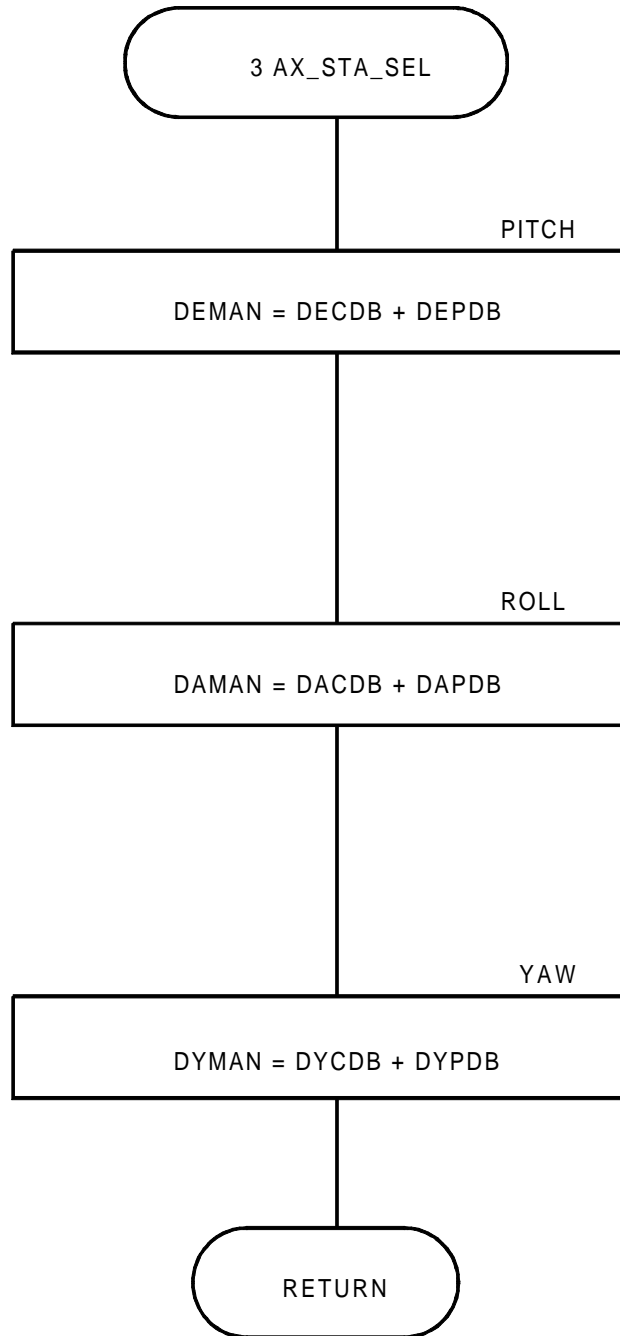


FIGURE 5.171-5. 3 AX_STA_SEL Functional Module

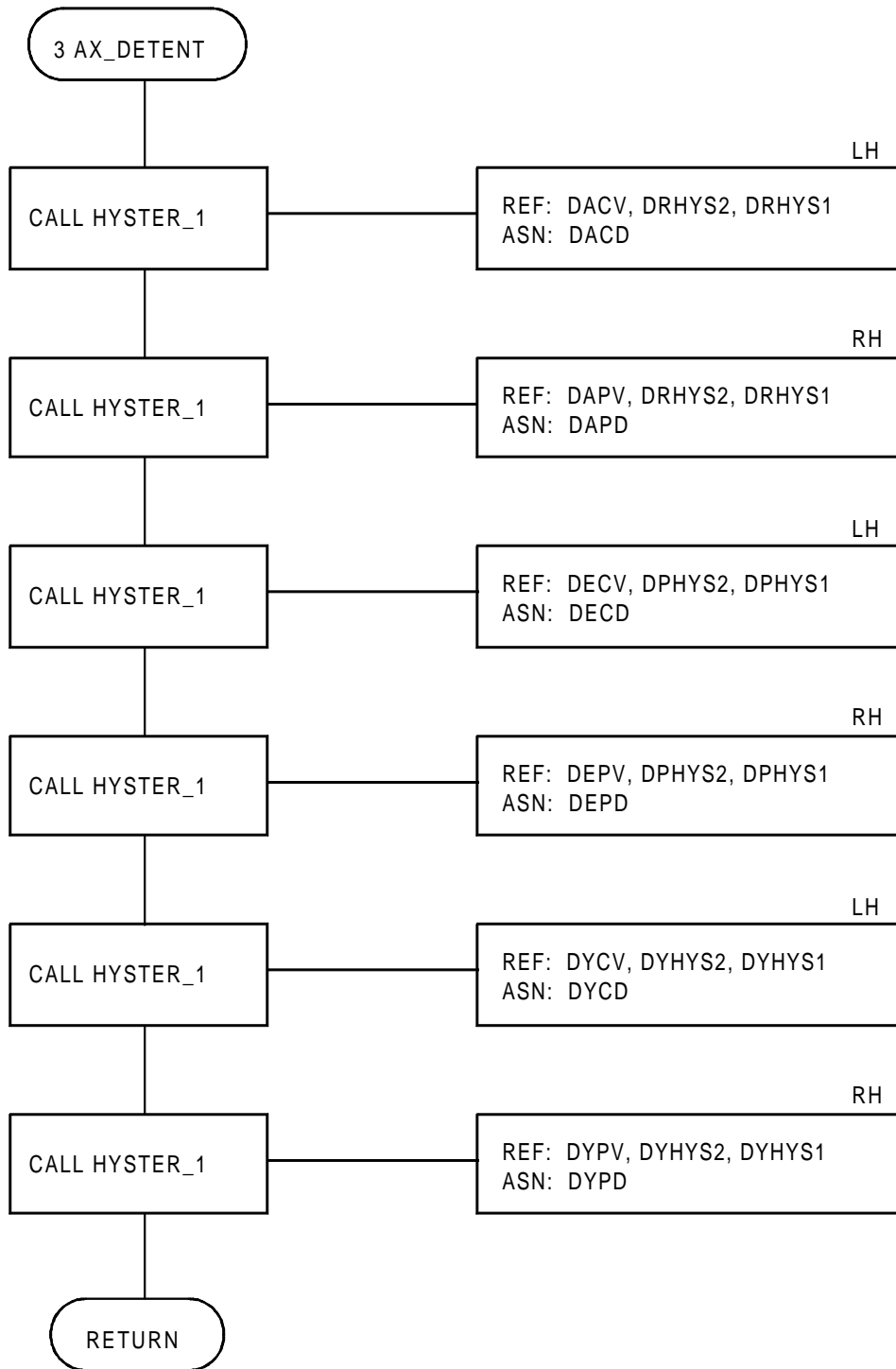


FIGURE 5.171-6. 3 AX_DETENT Functional Module

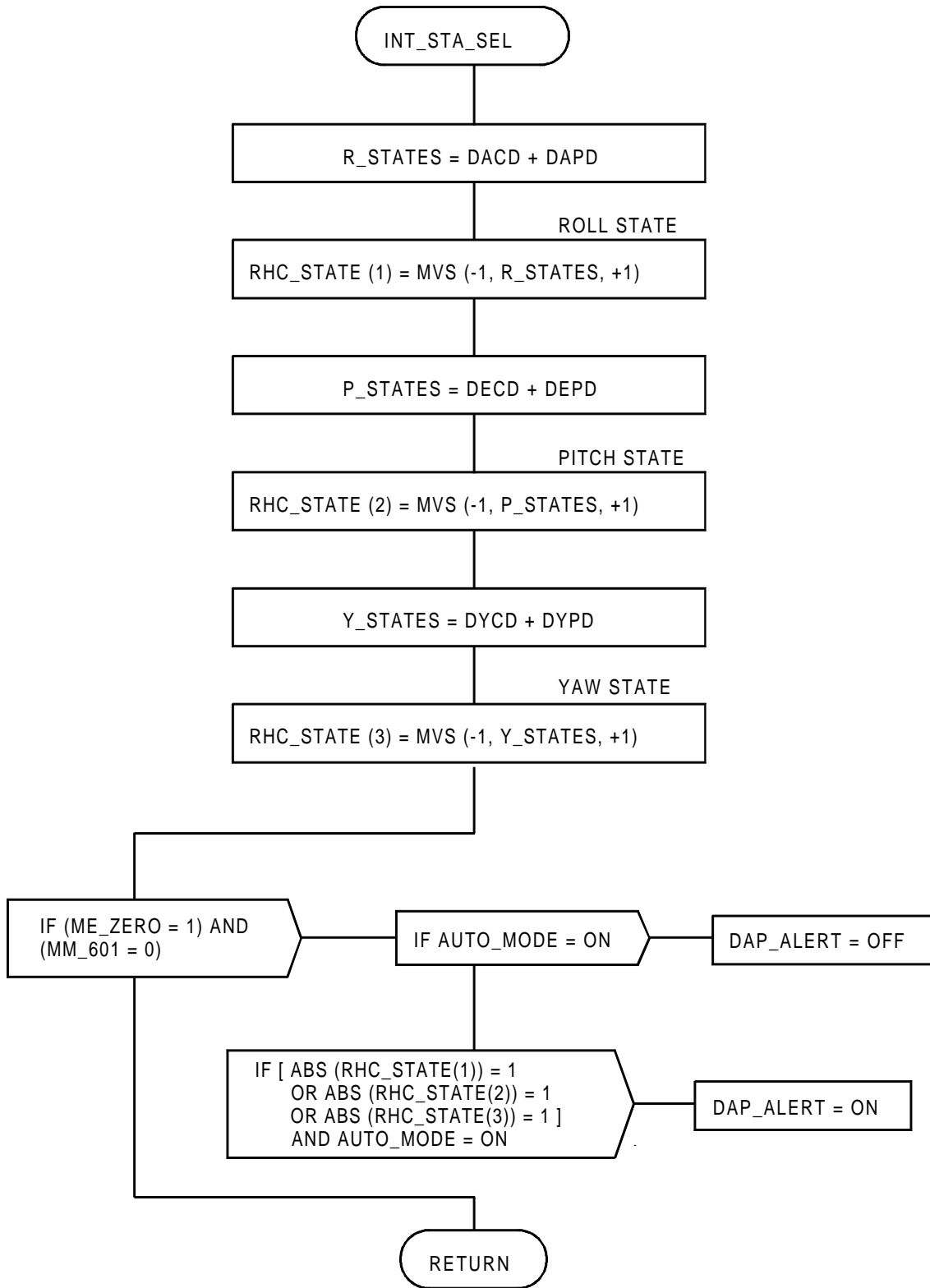


FIGURE 5.171-7. INT_STA_SEL Functional Module

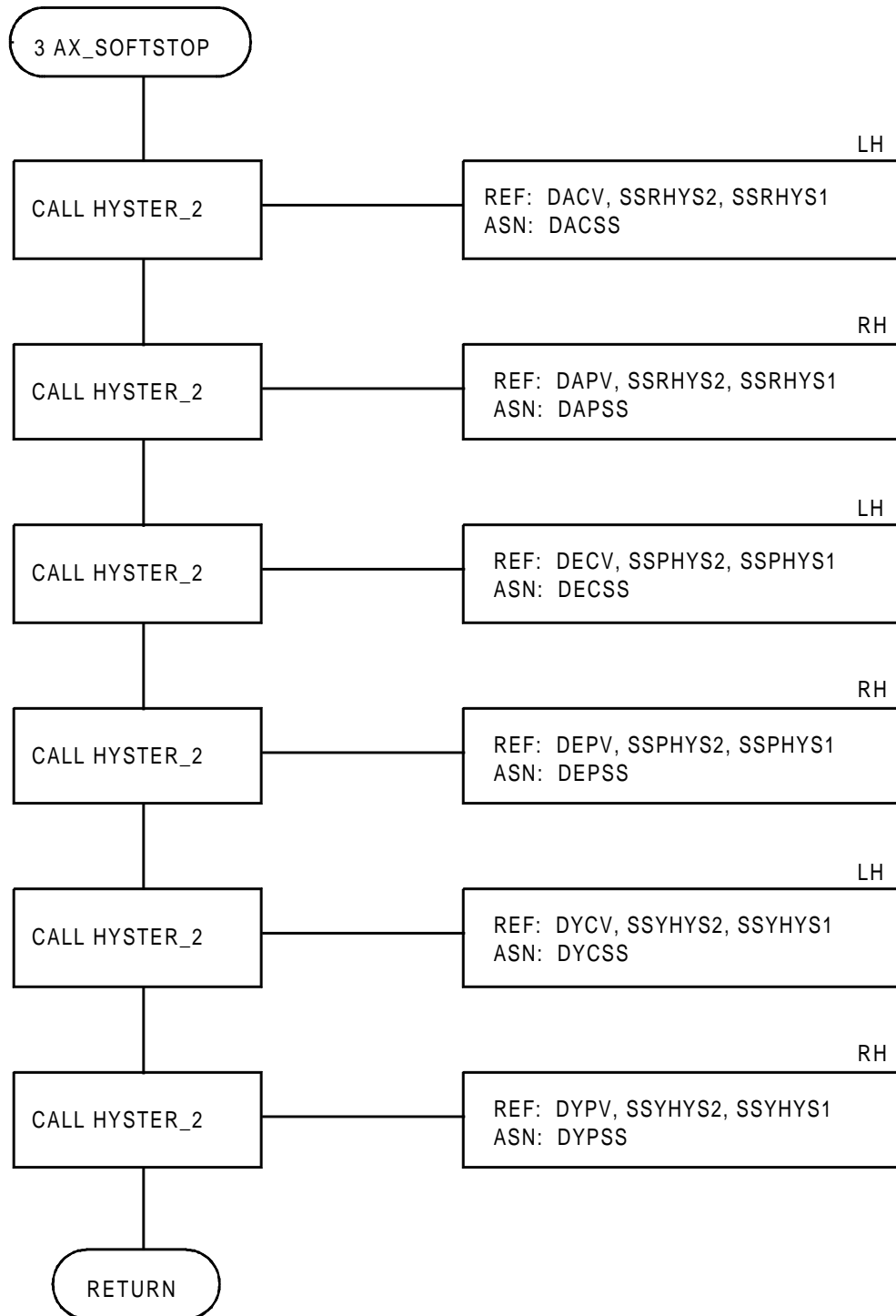


FIGURE 5.171-8. 3 AX_SOFTSTOP Functional Module

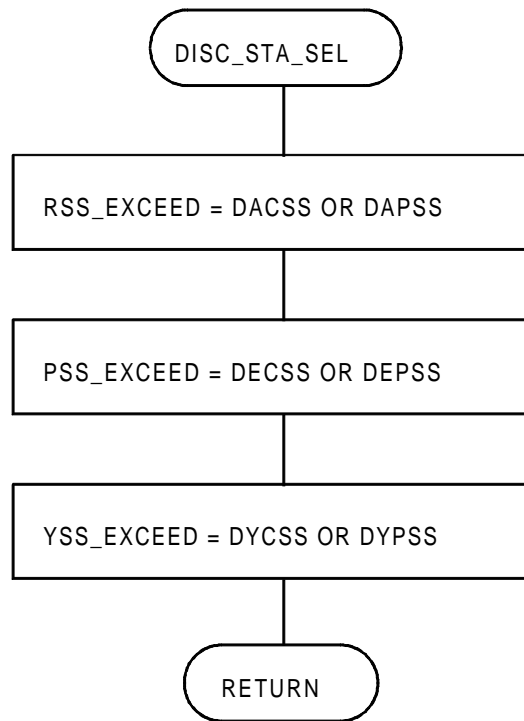


FIGURE 5.171-9. DISC_STA_SEL Functional Module

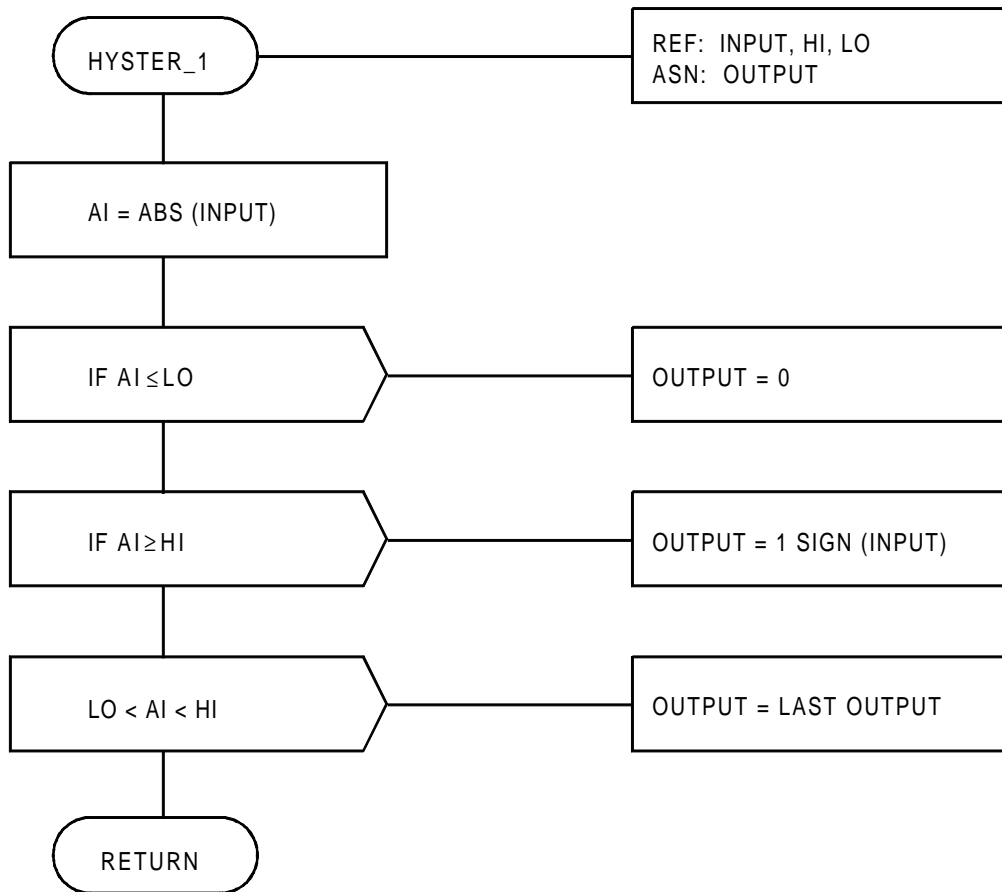


FIGURE 5.171-10. HYSTER_1 Common Module

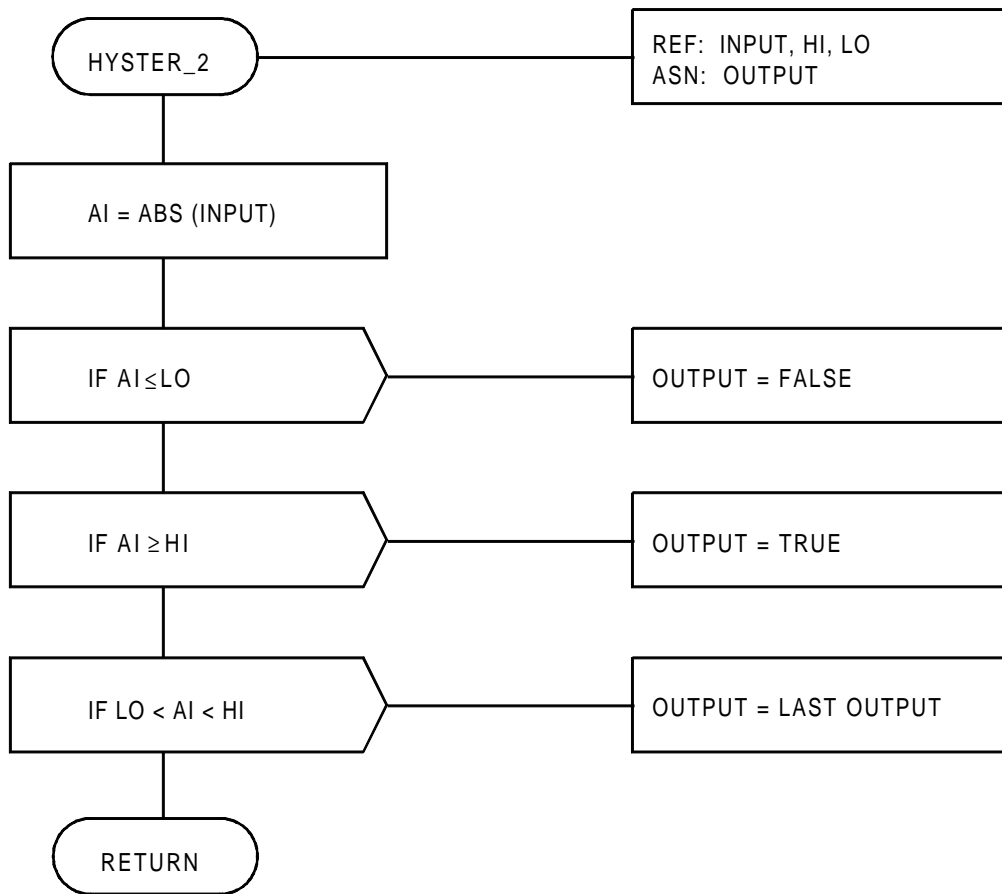


FIGURE 5.171-11. HYSTER_2 Common Module

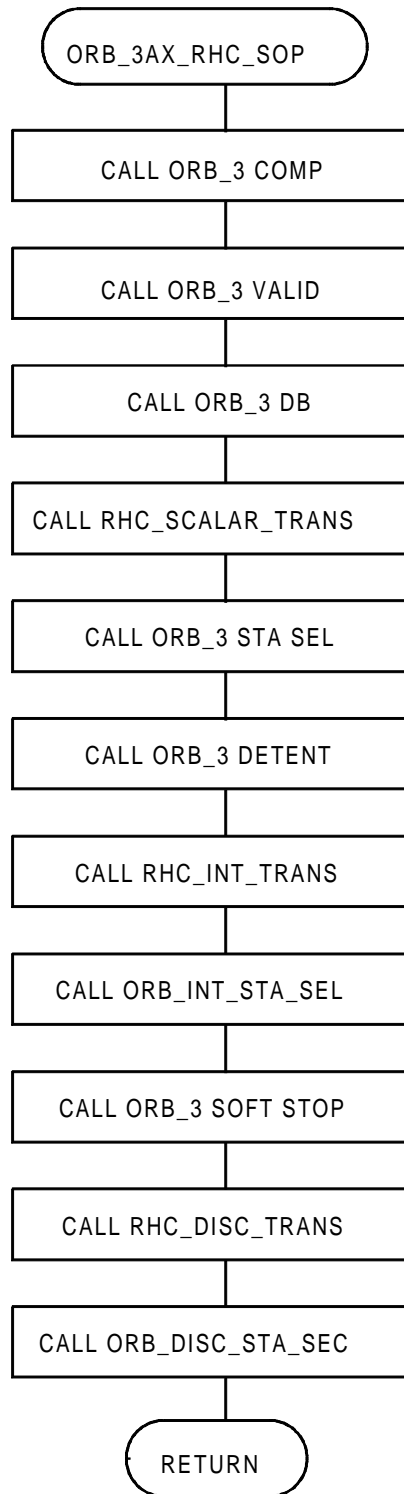


FIGURE 5.199-1. ORB_3AX_RHC_SOP Functional Module

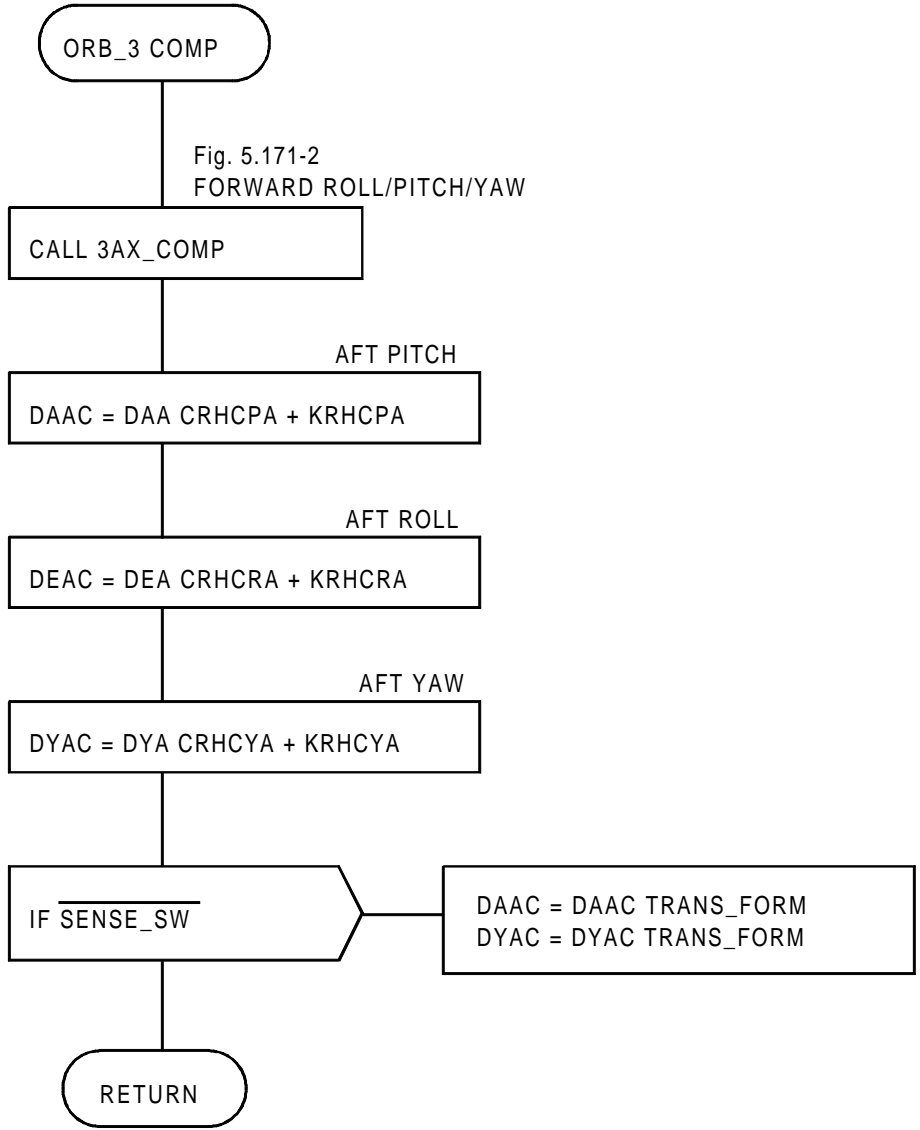


FIGURE 5.199-2. ORB_3_COMP Functional Module

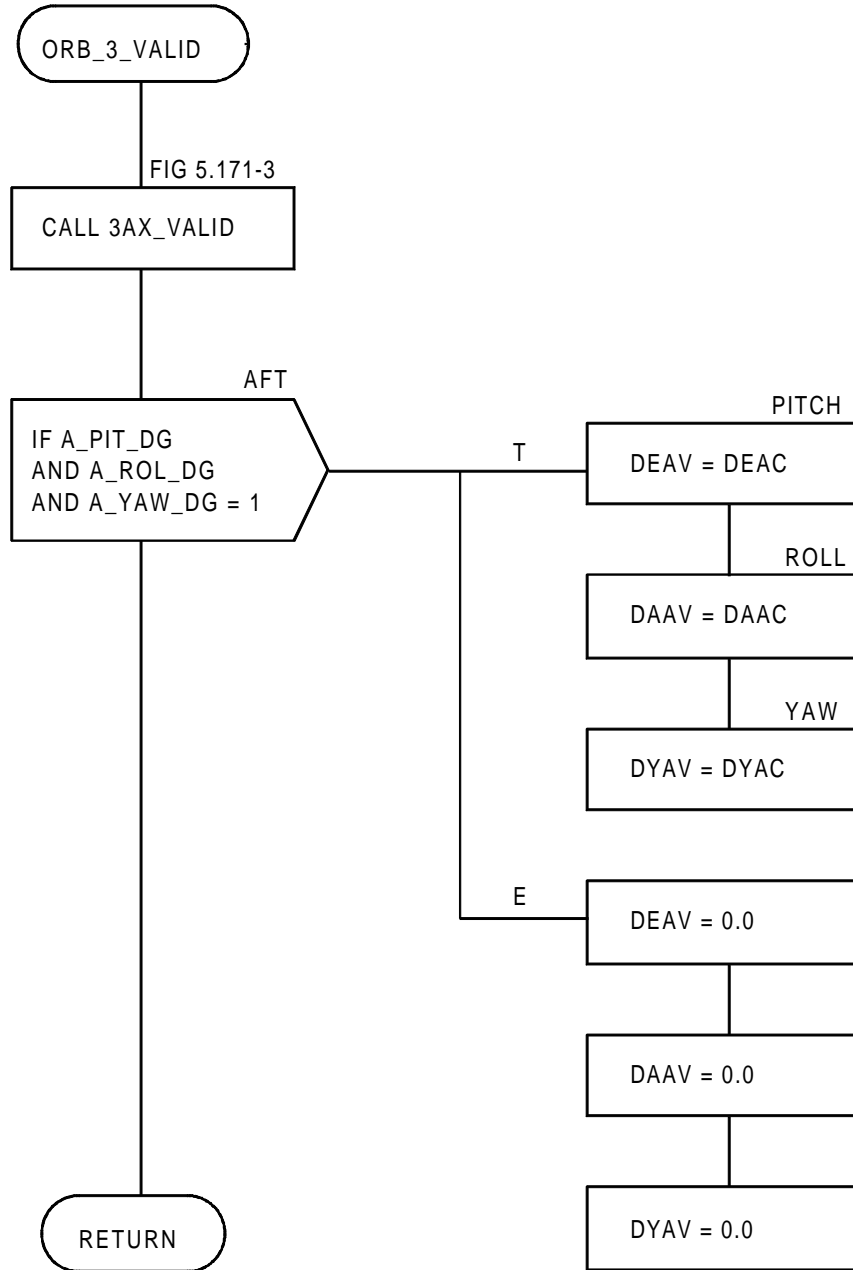


FIGURE 5.199-3. ORB_3_VALID Functional Module

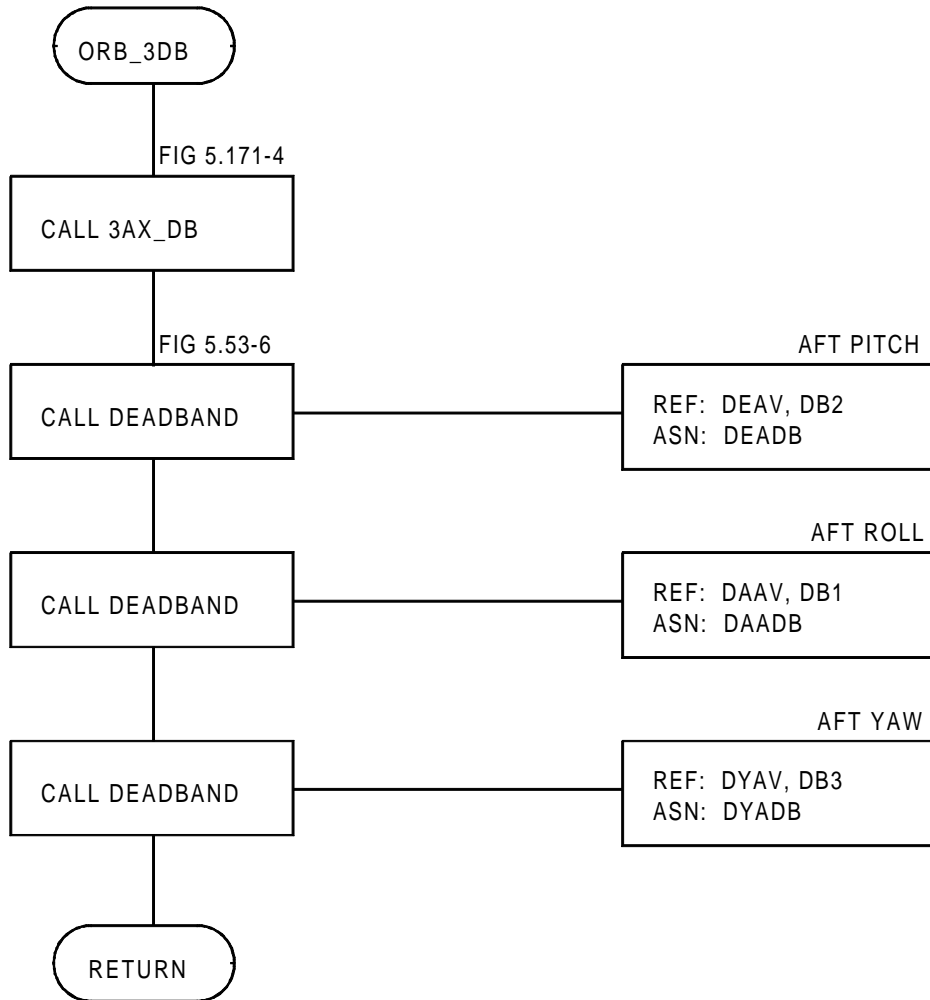


FIGURE 5.199-4. ORB_3DB Functional Module

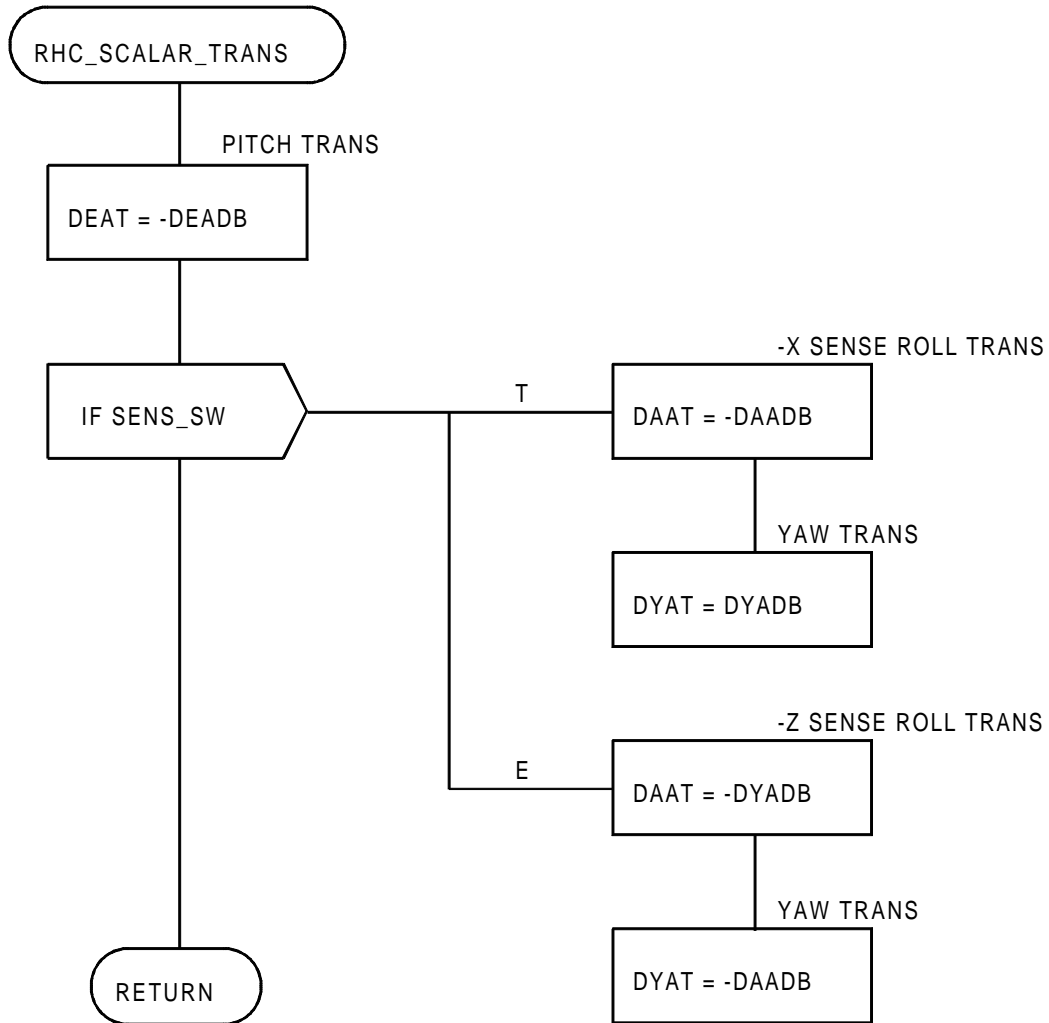


FIGURE 5.199-5. RHC_SCALAR_TRANS Functional Module

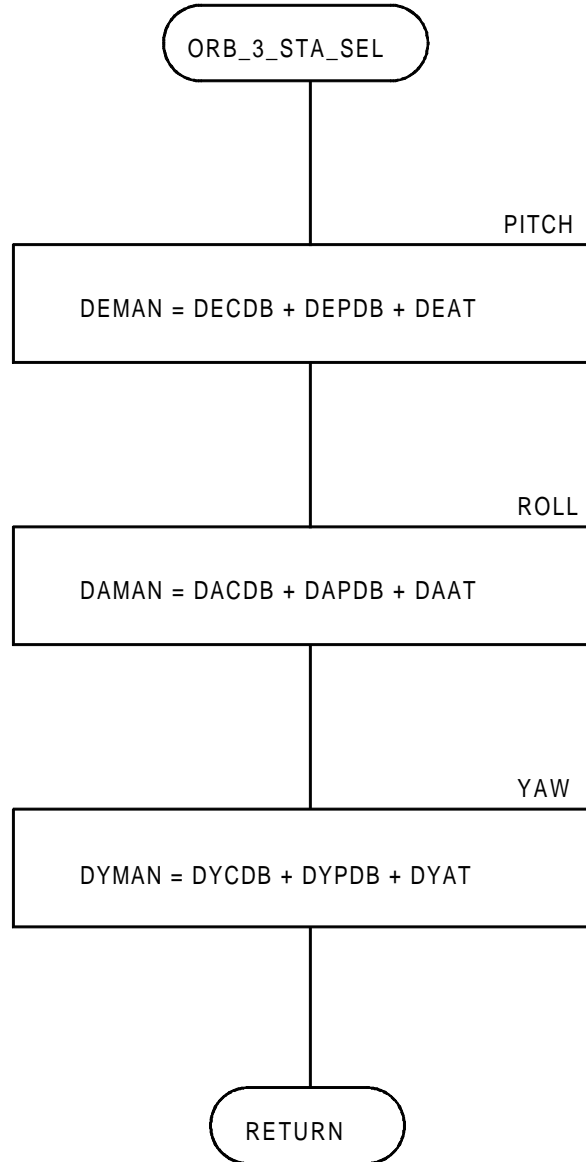


FIGURE 5.199-6. ORB_3_STA_SEL Functional Module

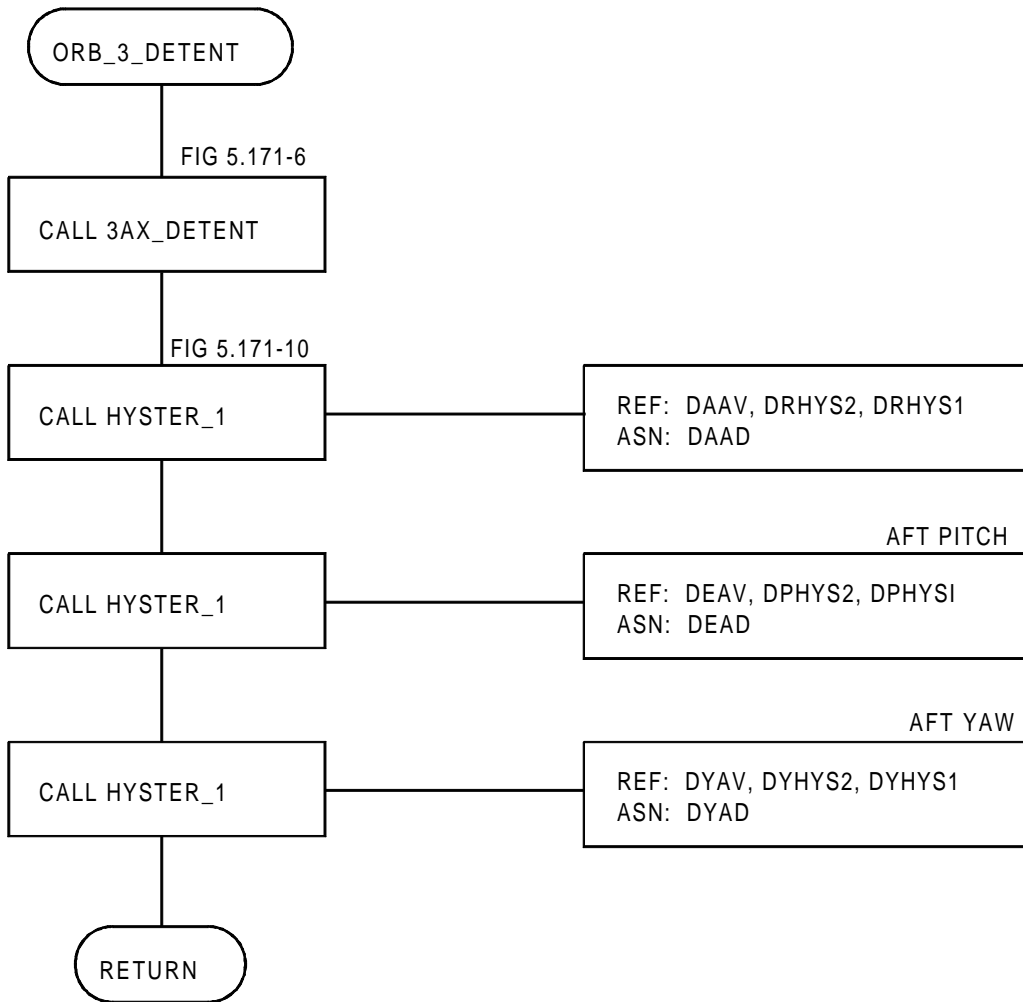


FIGURE 5.199-7. ORB_3_DETENT Functional Module

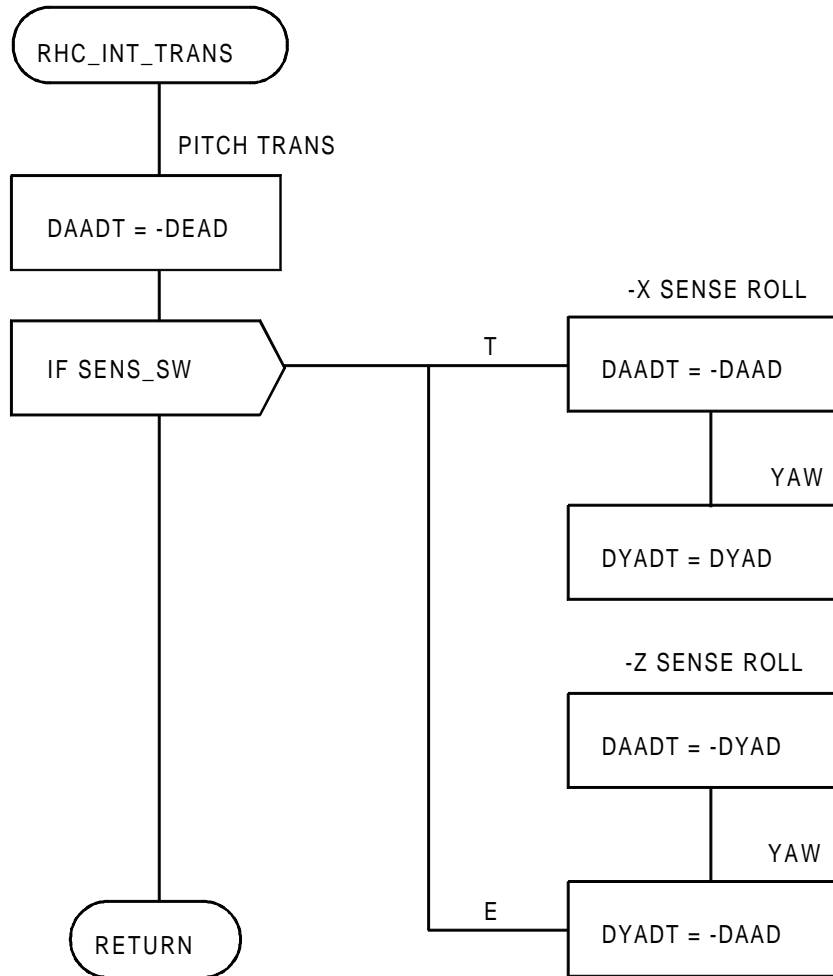


FIGURE 5.199-8. RHC_INT_TRANS Functional Module

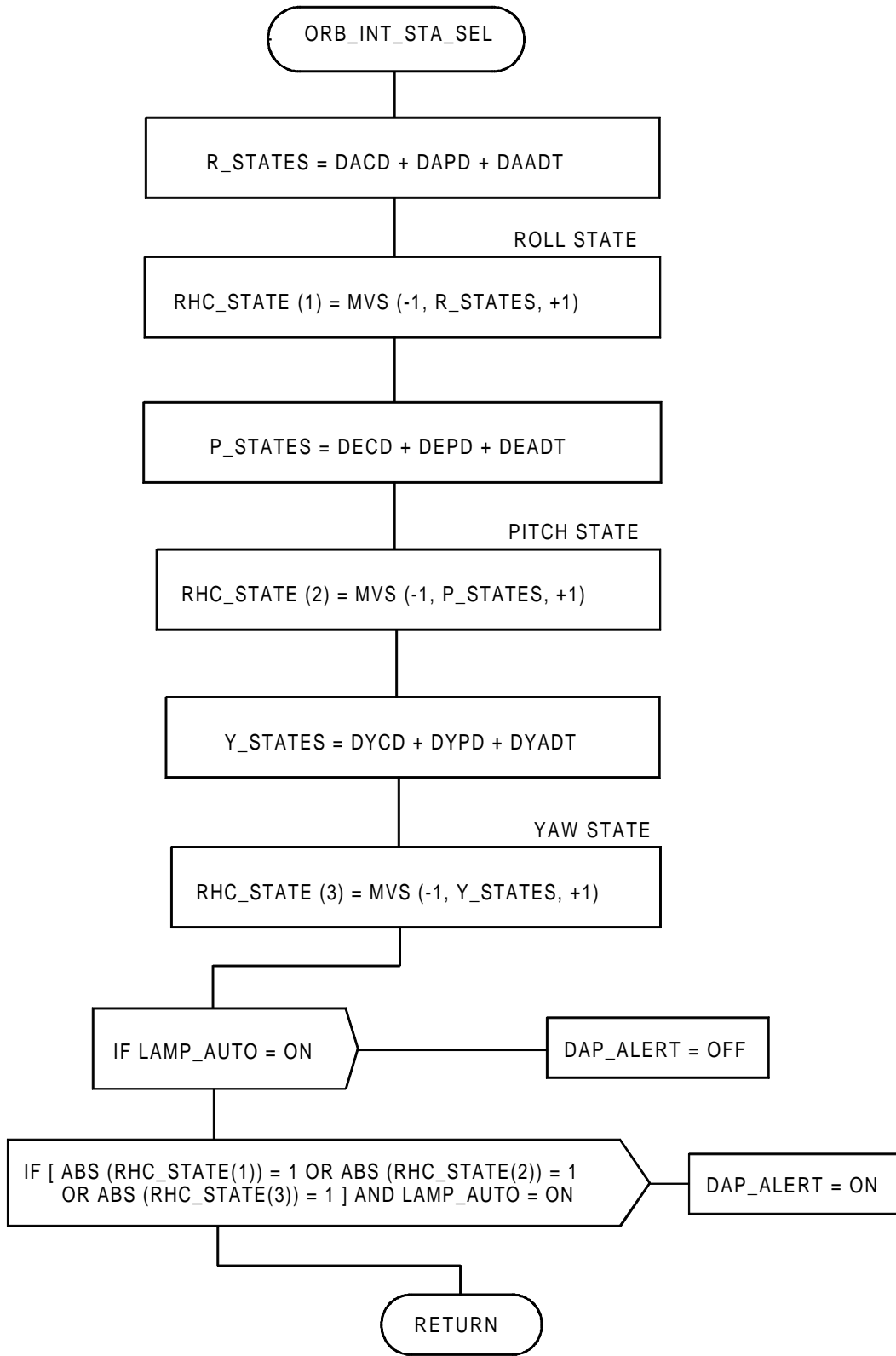


FIGURE 5.199-9. ORB_INT_STA_SEL Functional Module

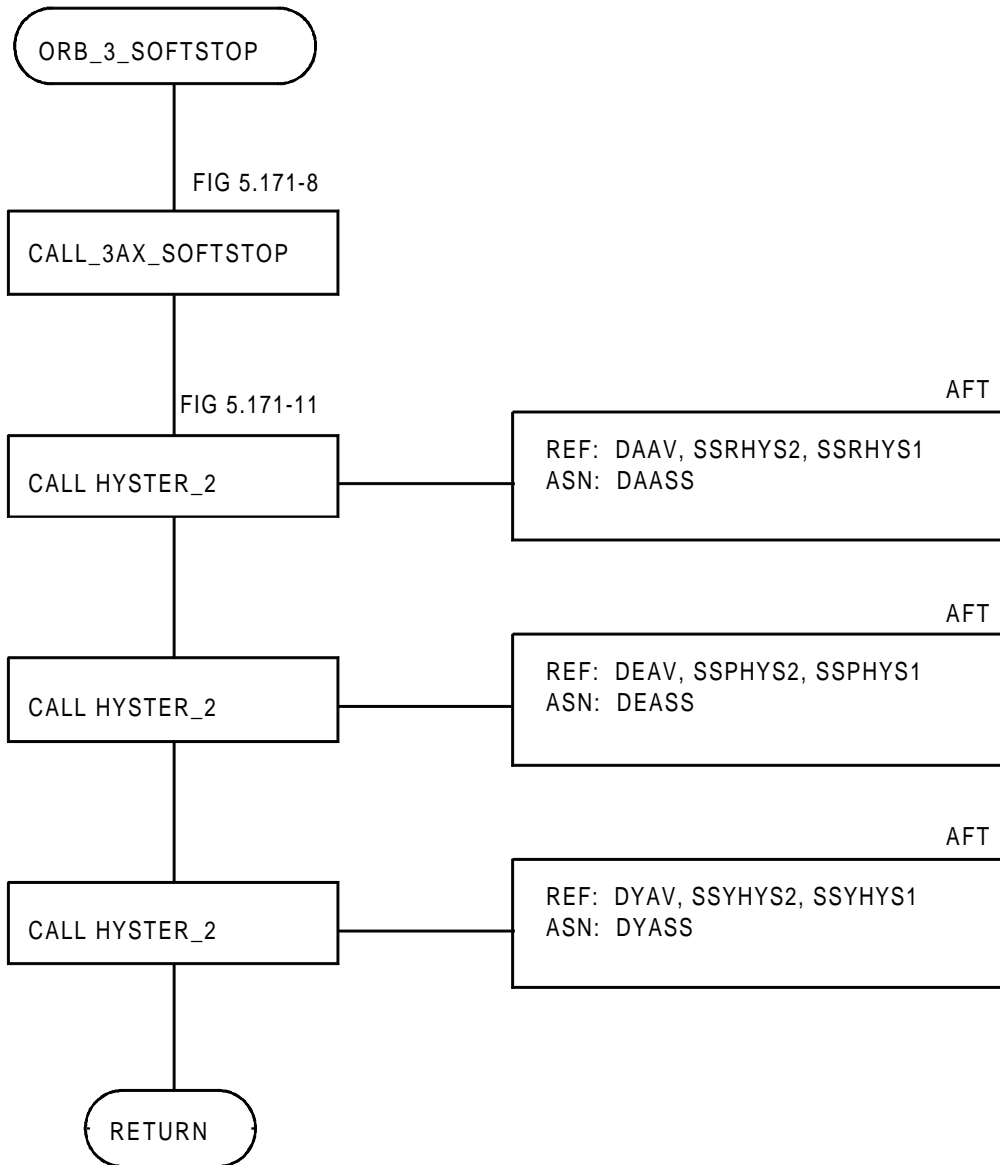


FIGURE 5.199-10. ORB_3_SOFTSTOP Functional Module

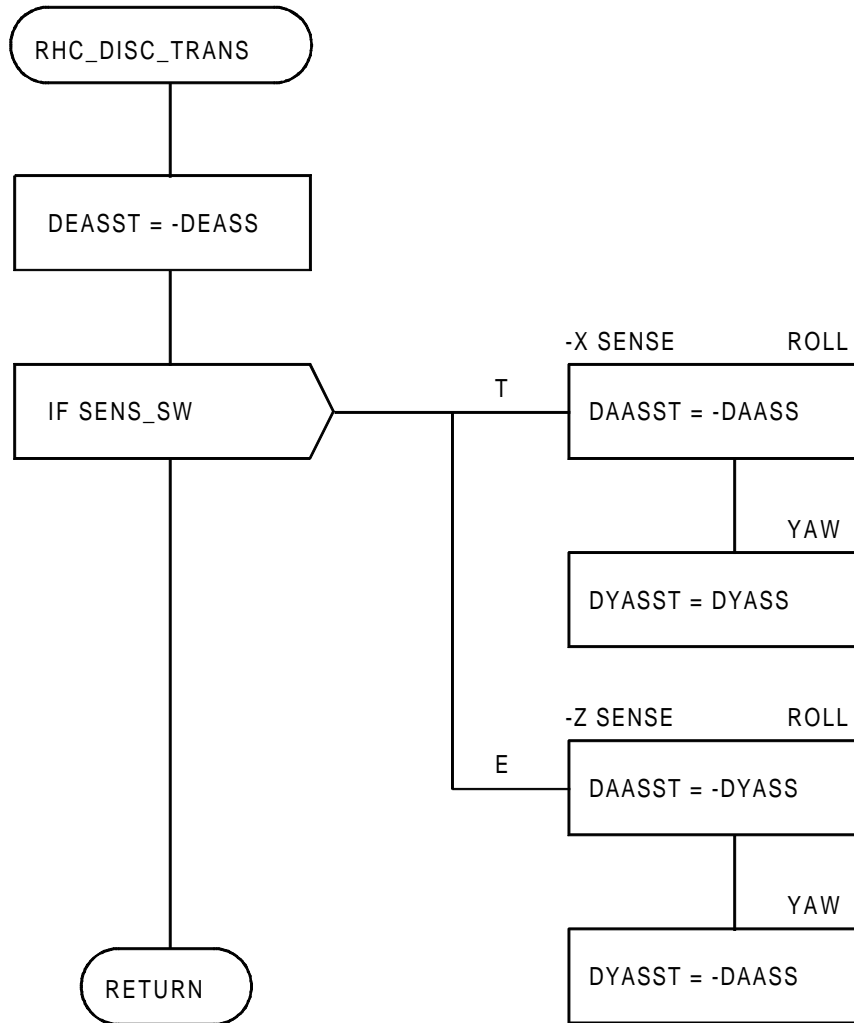


FIGURE 5.199-11. RHC_DISC_TRANS Functional Module

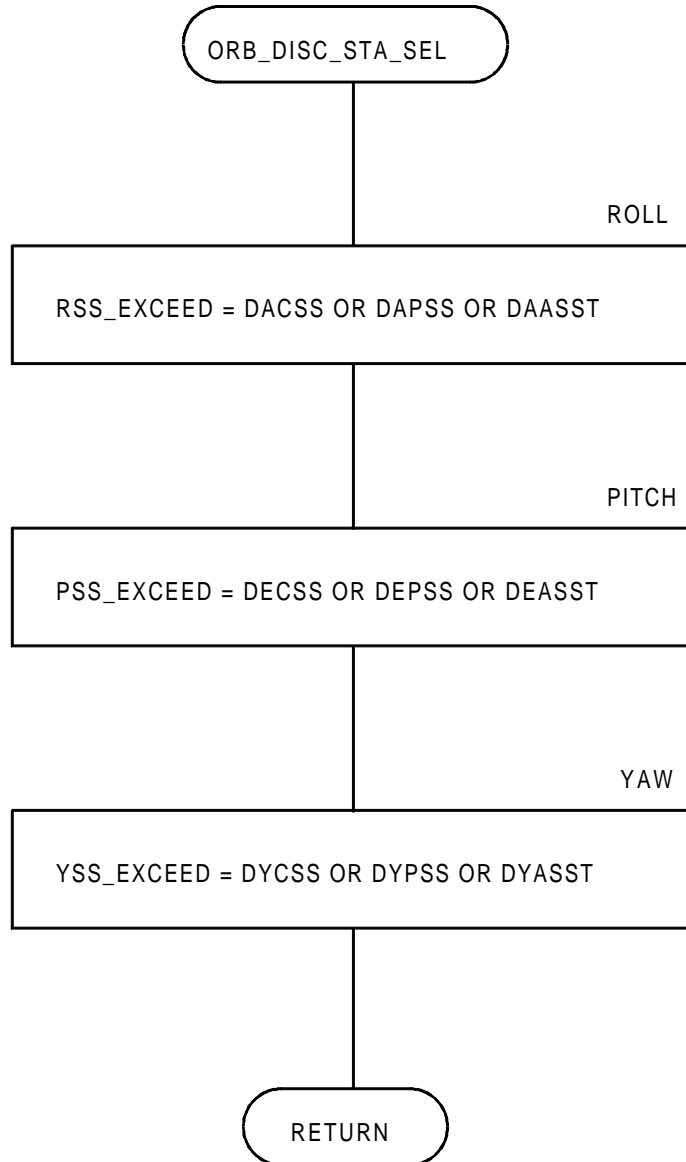


FIGURE 5.199-12. ORB_DISC_STA_SEL Functional Module

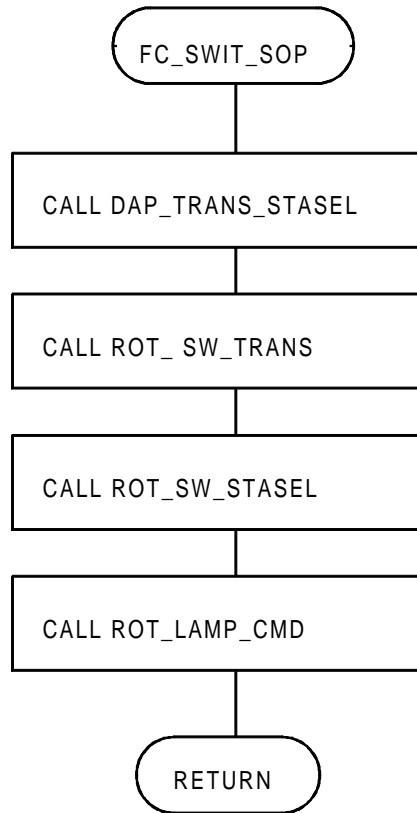


FIGURE 5.216-1. FC_SWIT_SOP Functional Module

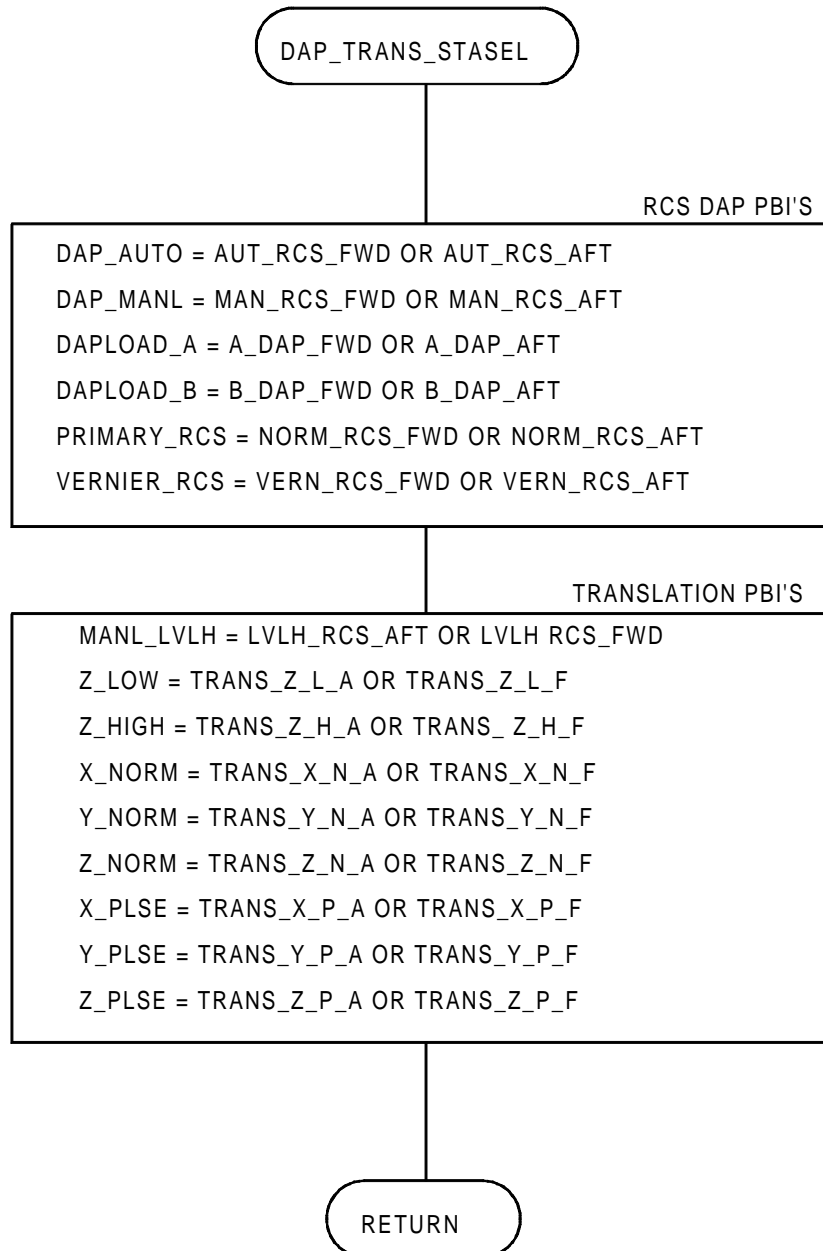


FIGURE 5.216-2. DAP_TRANS_STASEL Functional Module

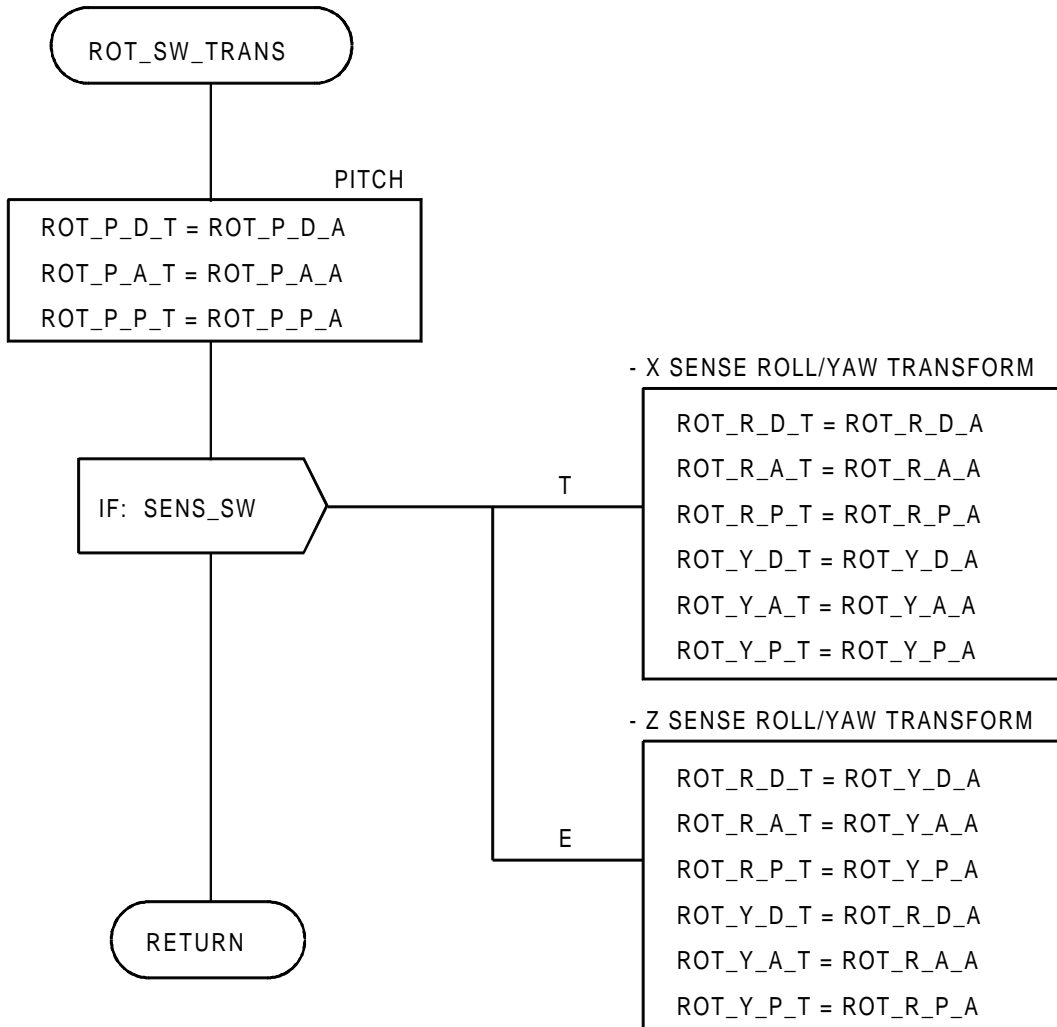


FIGURE 5.216-3. ROT_SW_TRANS Functional Module

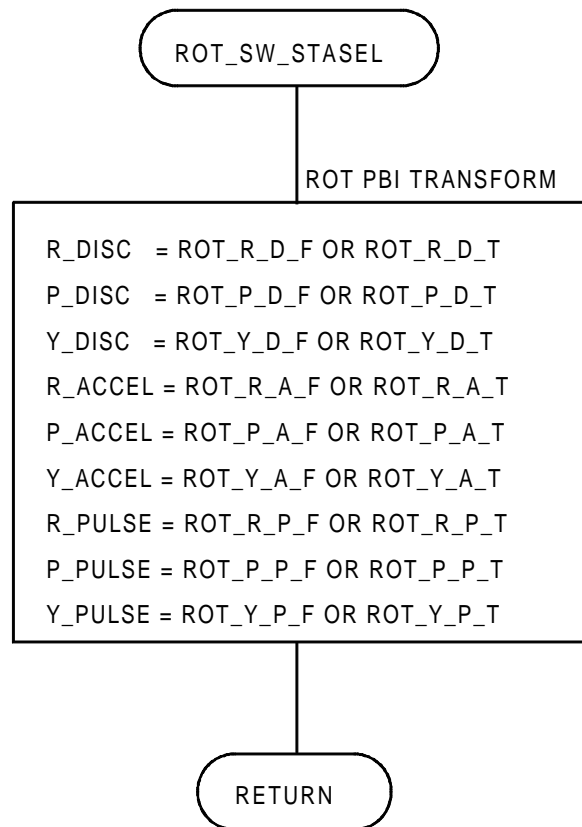


FIGURE 5.216-4. ROT_SW_STASEL Functional Module

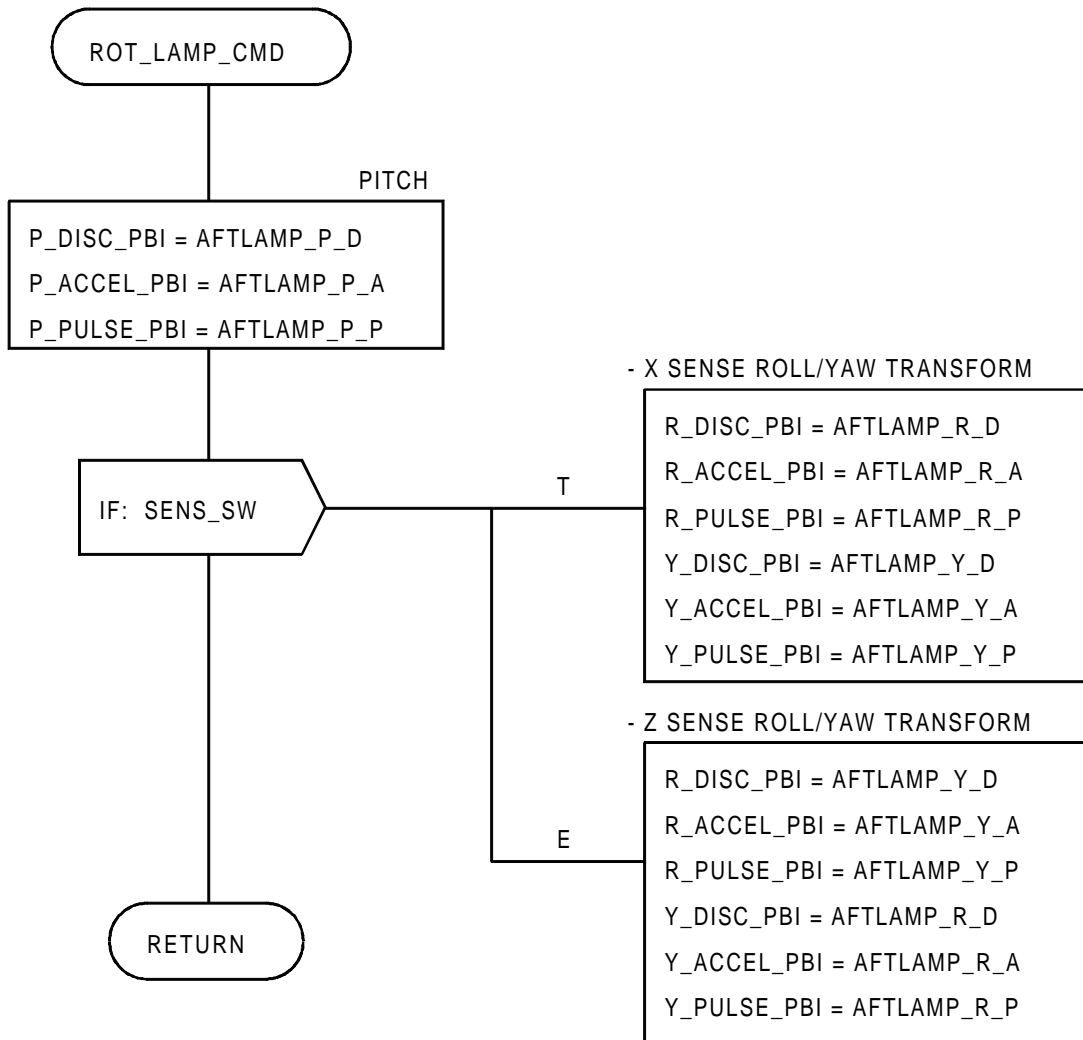


FIGURE 5.216-5. ROT_LAMP_CMD Functional Module

This page intentionally left blank.

6.0 GLOSSARY

6.1 LIST OF DEFINITIONS

AEROSURFACES – Those control surfaces that use the atmosphere through which the vehicle is moving to effect a change in the dynamic state of the vehicle.

AILERON – A specific control function of the elevon that produces vehicle motion about the body roll axis through differential deflection of the elevons.

AIR DENSITY – The ratio of the mass of local air to a unit of volume.

ALPHA/MACH INDICATOR – The panel instrument which displays equivalent airspeed, Mach, vehicle acceleration, and angle of attack.

ALPHA PRESSURE – Alpha pressures are those pressures used to compute the angle of attack. The alpha pressures are measured by the air data probes by pressure ports in the X-Z plane of the orbiter.

ALTITUDE/VERTICAL VELOCITY INDICATOR – The panel instrument which displays radar altitude, barometric altitude, altitude rate, and altitude acceleration.

ANGLE OF ATTACK – The angle of attack is the angle between the mean chord of the wing and the wind vector.

APPLICATION PROGRAM – The software which actually performs the mission-related functions in the areas of guidance, navigation and control, system management, and payload handling. The FCOS and FCOS-related support software are not included.

AREA NAVIGATION – Navaid navigation using derived range and bearing from a waypoint. The waypoint is offset from the ground station. The range and bearing from the ground station to the waypoint and from the ground station to the vehicle are combined to generate range and bearing from the waypoint to the vehicle.

ASSIGN – ASSIGN refers to a category of interface parameters for data modules. The ASSIGN category contains those parameters which are either (a) required as input to the common module and are assigned new values, or (b) generated by the common module and supplied as output data.

ATTITUDE DIRECTOR INDICATOR – The panel instrument which displays vehicle attitude, attitude rates, and attitude errors.

BAROMETRIC ALTITUDE INDICATOR – An altitude indicator sensitive to local air pressure and calibrated to read in height above mean sea level. **BAROSET** – Baroset is a method of correcting for barometric deviations from standard day conditions at the landing site. The correct barometric reading is input by the crew via the keyboard.

BETA – The angle that the vehicle's velocity vector makes with the body X axis (side slip angle).

BREAKOUT – The boundaries that surround a deadband zone which, when exceeded, allow signals to be crossed.

BUILT-IN TEST EQUIPMENT (BITE) – Hardware circuitry within a unit that provides internal detected fault indications. In general, a combination of BITE and additional software checking functions are used to incorporate the FDI techniques for the systems.

STS 83-0015-34
December 14, 2007

CALL – The process of scheduling or transferring control from one module to another that is inserted in the sequence of operations to perform a secondary purpose.

CASTER – Allowing the nosewheel to rotate freely about its Z axis within its mechanical limits.

COMMON MODULE – A common module consists of a set of related functions which, when called by other modules, performs a specific common task.

COMPOOL – This is the HAL/S mechanization for a common data pool which is available for use by all software functions that have access rights.

CORRECTED STATIC PRESSURE – Corrected static pressure is the measured static pressure corrected for probe errors due to angle of attack and Mach variations.

CORRECTED TOTAL PRESSURE – Corrected total pressure is the measured total pressure corrected for probe errors due to angle of attack variations.

COUNTS – Counts are defined as the integer decimal equivalent of a binary number.

CYCLIC FUNCTION – A function which regularly and predictably recurs at specific points during a defined time interval. (See also PERIODIC.)

CYCLIC I/O – Inputs and outputs regularly submitted to or sent from the IOP.

DATA MODULE – A data module specifies the interface parameters for common modules. The interface parameters are categorized as either ASSIGN or REFERENCE parameters.

DATA PROCESSING SUBSYSTEM – The collection of data transfer, storage, and processing equipment which includes the following: (1) general purpose computers, (2) multifunction CRT display systems, (3) mass memory units, (4) MDM's, (5) EIU, (6) associated bus network out to BTU, and (7) intercomputer discrete lines.

DEADBAND – A zone within which the outputs are nulled.

DEPLOYED – In an extended or using position.

DETENT – The mechanical equilibrium point in hand controllers where all controller outputs are zero.

DIFFERENTIAL – Equivalent movement in opposite directions.

DISCRETE – A two-state variable generated by or for the GN&C LRU's.

DISPLAY DRIVER UNIT – The electronic unit for driving the Alpha/Mach Indicator, the Altitude/Vertical Velocity Indicator, the Altitude Director Indicator, and the Horizontal Situation Indicator.

DOWNLINK – Data formatted on the PCM Master Unit and RF transmitted from the vehicle to the ground.

DYNAMIC DATA – Data values contained in the GPC memory that change or can be changed as a result of system inputs or software processing.

DYNAMIC PRESSURE – Dynamic pressure is the pressure to the forward motion of the vehicle.

DYNAMICS – A condition of the vehicle resulting from its stability and motion and those conditions which reflect vehicle disturbances created when changes in its equilibrium are induced.

ELEVATOR – A specific control function of the elevon that produces vehicle motion about the body pitch axis through symmetric deflection of the elevons.

ELEVON – A dual-purpose aerosurface that combines the pitching effect of elevators with the rolling effect of ailerons in a single control panel mounted on each wing.

EQUIVALENT AIRSPEED – Equivalent airspeed is the speed of the vehicle relative to the local air mass as referenced to standard sea-level air density. At sea level in a standard atmosphere, equivalent airspeed is equal to true airspeed.

EVENT LAMPS – A series of lamps mounted on the glare shield and used to signal to the pilot the occurrence of certain events during mission operations.

EXECUTE – To perform or to carry out into effect a given function or process.

FAULT DETECTION AND ANNUNCIATION (FDA) – This function provides fault detection and crew notification of a fault with no identification of the fault cause.

FAULT DETECTION AND IDENTIFICATION (FDI) – The redundancy management function providing system fault detection, annunciation and identification of the cause of a fault.

FAULT DETECTION, IDENTIFICATION, AND RECOVERY (FDIR) – This is the same function as FDI with the addition of automatic reconfiguration.

FEEDBACK – A closed-loop process of introducing into the software computations the system reaction resulting from a software generated stimulus.

FIXED POINT – A signed binary number in which the fixed location of the binary point is assumed.

FLARED RUDDER – A dual-purpose aerosurface that combines the yawing effect of a rudder with the aerodynamic braking effect of a speed brake in a tailmounted split-panel.

FLOATING POINT – A signed decimal number in which provisions are made for varying the location of the decimal point by means of exponent notation.

FORCE EFFECTOR – The vehicle elements that interact directly with the environment to alter the dynamic state of the vehicle.

FORMULATION – Formulation indicates a method of implementing a given set of requirements. The formulations are provided in HAL/S structured flow chart form.

FUNCTION – A task to be performed by software (see principal and specialist functions).

FUNCTIONAL MODULE – A functional module is defined as a set of related subfunctions grouped together which performs a specific task.

GEODETIC LOCAL VERTICAL – Presumes a reference ellipsoid of revolution which approximates the figure of the earth; then the local vertical at any point is along the unique line that is normal to the ellipsoid surface and contains the point of interest.

GN&C MAJOR FUNCTION – Guidance, Navigation, Flight Control, Redundancy Management/Moding, Sequencing and Control, Subsystem Operating Programs, or Displays and Control.

GPC DOWNLIST – A table of values compiled within a GPC and sent to the PCM Master Unit for downlink telemetry.

STS 83-0015-34
December 14, 2007

GROUND SPEED – Foot sum square of X–component of velocity (downrange) and Y–component of velocity (crossrange) relative to touchdown point.

HAL/S – The programming language for the Space Shuttle software.

HORIZONTAL SITUATION INDICATOR – The panel instrument which displays Navaid information to the operator in the form of range and elevation and course and glide slope deviations with respect to some Navaid ground station or waypoint.

INBOARD ELEVON – The elevon located nearest to the body of the vehicle.

INTEGER – A signed whole number.

INTERFACE UNITS – A term which describes any device physically connected to the GPC via a serial digital data bus or discrete interfaces.

ISSUE – Transmission of a command or data word from the general purpose computer to an interface unit.

LANDING – Flight state of the vehicle which extends from main wheel touchdown to the point where the vehicle comes to a complete stop.

LANDING GEAR – The undercarriage of an aircraft that consists of the main wheels under each wing and the nosewheel in the forward portion of the vehicle.

LANDING GEAR STATUS – A discrete indication that the main and nose landing gear are either retracted or extended.

LATERAL – Vehicle translational movement along the Y axis in body coordinates.

LOGICAL – A two–state variable generated by and for application program usage.

LONGITUDINAL – Vehicle translational movement along the X axis in body coordinates.

MACH NUMBER – Mach number is the ratio of the vehicle’s true airspeed to the local speed of sound.

MAJOR CYCLE – The time interval defined by the lowest frequency periodic function execution rate.

MAJOR FUNCTION – GN&C, SM, or payload.

MAJOR MODE – A collection of functions that may be scheduled by the software or that may be called by the crew.

MINOR CYCLE – The time interval defined by the highest periodic function execution rate.

MODULE – A functional module or a common module.

MOTION SENSORS – Those instrumented sensors that monitor vehicle dynamics.

NORMAL – Vehicle translational movement along the Z axis in body coordinates.

NOSEWHEEL STEERING ENABLE – A discrete indication generated when the vehicle decelerates to a velocity which is considered safe to initiate nosewheel steering.

NOSEWHEEL STEERING ROLLOUT VELOCITY – That particular speed during the rollout period after nosewheel touchdown at which ground steering with the nosewheel becomes an effective method of guiding the vehicle through the remainder of the deceleration run.

NULL – The condition of a zero output or input.

OPERATIONAL FLIGHT PROGRAM – Represents the total computer program which operates in the Orbiter general purpose flight computer subsystem.

OPERATIONAL SEQUENCE – The highest level of OFP organization. The crew selects operational sequences to initiate software processing to accomplish the mission phases. Each operational sequence consists of a collection of sequentially ordered major modes.

OUTBOARD ELEVON – The elevon located farthest from the body of the vehicle.

PERIGEE AND APOGEE – The unique points in an elliptic orbit about the earth where the object achieves minimum and maximum distances from the center of the earth irrespectively.

PERIODIC FUNCTION – A function whose computation and I/O processing requires cyclic execution of a code sequence to satisfy the mission objective.

PRESSURE ALTITUDE – Pressure altitude is the altitude of the vehicle (in geopotential feet) as derived from corrected static pressure and barometric correction (baroset) inputs. It is referenced to the U.S. Standard Atmospheres, 1962 model.

PRESSURE ALTITUDE RATE – Pressure altitude rate is the rate of change of the vehicle's pressure altitude.

PRINCIPAL FUNCTION – A function that can only be initiated by the software. Principal functions may be ordered sequentially, run in parallel, enabled or inhibited.

PROCESS – The software operations in which a series of actions, changes, or functions are performed to bring about a particular result.

PUSHBUTTON INDICATOR – A group of lighted panel switches for operator input to the software.

RADAR ALTITUDE – The altitude above ground level as measured by a Radar Altimeter.

REFERENCE – REFERENCE refers to a category of interface parameters for data modules. The REFERENCE category contains those parameters which are used by the common module as input reference data only. This category includes constants and variables which are required but whose values are not changed by the common module.

REQUIREMENT – That which is needed, obligatory, or demanded.

ROLLOUT – Period during landing that extends from the point of nosewheel touchdown to the point where the vehicle comes to a complete stop.

RUDDER – A specific control function of the flared rudder which produces vehicle motion about the body yaw axis through symmetric deflection of the flared rudder panels.

SELF-TEST – The software, upon keyboard request, generates a stimulus to a specified hardware LRU. The LRU responds according to design characteristics. The self-test stimulus remains until manually terminated.

SHALLOW GLIDE SLOPE – Portion of the atmospheric flight that extends from flare to final flare, during which the vehicle is in equilibrium glide conditions in the final approach plane.

STS 83-0015-34
December 14, 2007

SLAPDOWN – Portion of approach and landing that extends from the point of main wheel touchdown to the point of nosewheel touchdown.

SPECIALIST FUNCTION – A function that can only be initiated by the crew.

SPEED BRAKE – A specific control function of the flared rudder that performs airspeed control by aerodynamic braking through differential deflection of the flared rudder panels.

STATIC AIR TEMPERATURE – Static air temperature is defined as that temperature of the air undisturbed by the presence or motion of the vehicle. Static air temperature is frequently called by such names as free air temperature, ambient air temperature, and outside air temperature.

STATIC PRESSURE – Static pressure is the pressure of the air undisturbed by the presence or motion of the vehicle as measured by the air data probes.

STEEP GLIDE SLOPE – Portion of the atmospheric flight that extends from approach and landing interface to flare, during which the vehicle is executing energy management maneuvers.

STOWED – In a retracted or storage position.

SURFACE POSITION INDICATOR – The panel instrument for displaying the flight control aerosurface positions and the speed brake command.

TOTAL PRESSURE – Total pressure is the pressure measured by the air data probes and reflects the ambient pressure and the pressure due to motion of the vehicle.

TOTAL TEMPERATURE – Total temperature is the temperature measured by the air data probes and reflects the sum of the ambient air temperature and the adiabatic temperature rise due to bringing the air to rest against the surface of the probe.

TOUCHDOWN – Process of bringing the main wheels and/or the nosewheel in contact with the runway during the landing.

TRANSPORT LAG – In a closed-loop control system, it is defined to be the time interval from sampling sensor inputs to supplying the control commands.

TRIM – The ability to move a force effector with very fine control.

TRUE AIRSPEED – True airspeed is the speed of the vehicle relative to the local air mass. It is referenced to the local air density.

VALIDITY BIT – Each sensor data word will contain a bit indicating that the input to the sensor is of sufficient level to be distinguished from noise.

VECTOR – A floating point array which expresses both magnitude and direction.

WAYPOINT 1 – Shuttle point of tangency to the heading alignment cylinders for either nominal or minimum entry point.

WAYPOINT 2 – Runway touchdown point.

WEIGHT ON NOSEGEAR – A discrete indication that the nose wheel is or is not in contact with the ground.

WEIGHT ON WHEELS – A discrete indication that the main wheels are or are not in contact with the ground.

6.2 LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|--------|--|
| AA | Accelerometer Assembly |
| ACCELN | Acceleration |
| ACCLRM | Accelerometer |
| ACTR | Actuator |
| A/D | Analog to Digital |
| ADI | Attitude Director Indicator |
| ADS | Air Data Subsystem |
| ADTA | Air Data Transducer Assembly |
| AERO | Aerosurface |
| A/L | Approach and Landing |
| ALT | Approach and Landing Test |
| AMI | Alpha/Mach Indicator |
| AOA | Abort Once Around |
| APU | Auxiliary Power Unit |
| AS | Ascent |
| ASA | Aerospace Servo Amplifier |
| ASC | Ascent |
| ASN | Assign |
| ATT | Attitude |
| ATVC | Ascent Thrust Vector Control |
| ATVCD | Ascent Thrust Vector Control Driver |
| AUTO | Automatic |
| AVVI | Altitude/Vertical Velocity Indicator |
| BF | Body Flap |
| BITE | Built-in-Test-Equipment |
| Btu | British Thermal Unit |
| C | Centigrade (degrees) |
| CAPRI | Capacitance Rate Integrator |
| CDR | Commander (left seat) |
| CHAN | Channel |
| CM | Centimeters |
| CMD | Command |
| CMDR | Commander |
| CMDS | Commands |
| COMP'D | Compensated |
| CPDS | Computer Program Development Specification |
| CPU | Central Processing Unit |
| CR | Change Request |
| CRT | Cathode Ray Tube |
| CSS | Control Stick Steering |
| CTL | Control |
| CTLR | Controller |
| CTR | Counter |

| | |
|--------|---|
| CU | Cubic |
| C&W | Caution and Warning |
| DAP | Digital Autopilot |
| DC | Direct Current |
| D&C | Display and Control |
| DD | Dedicated Display |
| D/D | Dedicated Display |
| DDU | Display Driver Unit |
| DEG | Degree |
| DEST | Destination |
| DEU | Display Electronics Unit |
| DIP | Display Interface Processor |
| DIR | Direct |
| DISENG | Disengage |
| DPS | Data Processing Subsystem |
| DSBL | Disable |
| E | Else |
| EA | Each |
| EGB | Electronic Gimbal Box |
| EIU | Engine Interface Unit |
| E/L | Entry through Landing |
| ELVN | Elevon |
| ENBL | Enable |
| EPDCS | Electrical Power Distribution and Control Subsystem |
| ET | External Tank |
| F | False |
| FC | Flight Control |
| F.C. | Flight Critical |
| FCOS | Flight Computer Operating System |
| FCS | Flight Control Subsystem |
| FDA | Fault Detection and Annunciation |
| FDBK | Feedback |
| FDI | Fault Detection and Identification |
| FDIR | Fault Detection, Identification, and Recovery |
| FLOAT | Floating |
| FLT | Flight |
| FOH | First Order Hold |
| FSSR | Functional Subsystem Software Requirements |
| FT | Foot |
| FUNCT | Function |
| FWD | Forward |
| g | Gravity (gravitational unit of force) |
| G&C | Guidance and Control |
| GMT | Greenwich Mean Time |
| G&N | Guidance and Navigation |
| GN&C | Guidance, Navigation, and Control |
| GPC | General Purpose Computer |
| GUID | Guidance |

| | |
|--------|----------------------------------|
| HI | High |
| HSI | Horizontal Situation Indicator |
| HYDR | Hydraulic |
| Hz | Hertz |
| IAS | Indicated Air Speed |
| IMU | Inertial Measurement Unit |
| IN. | Inch |
| IN.-HG | Inches of Mercury |
| INBD | Inboard |
| I/O | Input/Output |
| IOP | Input/Output Processor |
| K | Kelvin (degrees) |
| KBU | Keyboard Unit |
| kg | Kilograms |
| km | Kilometers |
| KYBD | Keyboard |
| L | Left |
| LAT | Lateral |
| LB | Pounds (force) |
| LBM | Pounds Mass |
| LCA | Load Control Assembly |
| LIB | Left Inboard |
| LNDG | Landing |
| LO | Low |
| LOB | Left Outboard |
| LPS | Launch Processor Subsystem |
| LRU | Line Replaceable Unit |
| LSB | Least Significant Bit |
| m | Meters |
| MAN. | Manual |
| MAX | Maximum |
| MCDS | Multifunction CRT Display System |
| MDM | Multiplexer/Demultiplexer |
| ME | Main Engine |
| MECO | Main Engine Cutoff |
| MET | Mission Elapsed Time |
| MHC | Manipulator Hand Controller |
| MHz | Megahertz |
| MIN | Minimum |
| MIN | Minute |
| MLG | Main Landing Gear |
| mm | Millimeters |
| M/M | Master Measurement |
| MML | Master Measurement List |
| MOL | Molecular Weight Unit |
| MPS | Main Propulsion System |
| ms | Millisecond |
| MSB | Most Significant Bit |

STS 83-0015-34
December 14, 2007

| | |
|--------|---|
| MSBLS | Microwave Scan Beam Landing System |
| MSC | Moding, Sequencing, and Control |
| msec | Millisecond |
| MSG | Message |
| MSS | Mission Specialist Station |
| MTC | Master Thrust Controller |
| N | Newtons |
| N/A | Not Applicable |
| NASA | National Aeronautics and Space Administration |
| NAV | Navigation |
| NAVDAD | Navigation Derived Air Data |
| ND | Non-Dimensional |
| NLG | Nose Landing Gear |
| NMI | Nautical Miles |
| NO. | Number |
| NORM | Normal |
| NW | Nosewheel |
| OFF | Operational Flight Program |
| OFT | Orbital Flight Test |
| OI | Operational Instrumentation |
| OMS | Orbiter Maneuvering Subsystem |
| OPER | Operational |
| OPS | Operational Sequence |
| ORB | Orbiter |
| OUTBD | Outboard |
| OWD | One-Way Doppler |
| P | Pitch |
| PAPM | Parameter |
| PBI | Pushbutton Indicator |
| PDR | Program Design Review |
| PFB | Position Feedback |
| PHS | Payload Handling Subsystem |
| PIC | Pyro Indicator Controller |
| PL | Payload |
| PLD | Payload (alternate P/L) |
| PLT | Pilot (right seat) |
| POSN | Position |
| PRESS | Pressure |
| PSI | Pounds per Square Inch |
| PSIA | Pounds per Square Inch Absolute |
| PT | Point |
| PWR | Power |
| R | Right |
| R | Roll |
| RA | Radar Altimeter |
| RAD | Radians |
| RCS | Reaction Control Subsystem |
| REF | Reference |

| | |
|---------|-----------------------------------|
| RG | Rate Gyro |
| RGA | Rate Gyro Assembly |
| RHC | Rotational Hand Controller |
| RIB | Right Inboard |
| RID | Review Item Disposition |
| RJD | Reaction Jet Driver |
| RJDA | Reaction Jet Driver Aft |
| RJDF | Reaction Jet Driver Forward |
| RJOD | Reaction Jet/OMS Driver |
| RM | Redundancy Management |
| ROB | Right Outboard |
| RPT | Rudder Pedal Transducer |
| RPTA | Rudder Pedal Transducer Assembly |
| RR | Rendezvous Radar |
| RREU | Rendezvous Radar Electronics Unit |
| RTLS | Return to Launch Site |
| RUD | Rudder |
| SB | Speed Brake |
| SBTC | Speed Brake Thrust Controller |
| SBTO | Speed Brake Takeover |
| SCB | Steering Control Box |
| SDR | System Design Review |
| SDS | Steering and Damping Subsystem |
| SEC | Second |
| SEL | Selected |
| SF | Selection Filter |
| SFC | Selection Filter Control |
| SIG | Signal |
| SM | System Management |
| SMRD | Spin Motor Running Detector |
| SOP | Subsystem Operating Program |
| SP BK | Speed Brake |
| SPD BRK | Speed Brake |
| SPEC | Specialist Function |
| SPI | Surface Position Indicator |
| SQ | Square |
| SRB | Software Review Board |
| SRB | Solid Rocket Booster |
| SRM | Solid Rocket Motor |
| SSD | Spacecraft Software Division |
| SSO | Systems Software Office |
| SSME | Space Shuttle Main Engine |
| ST | Star Tracker |
| STIM | Stimulus |
| SW | Switch |
| S/W | Software |
| SYS | System |
| T | Then |

STS 83-0015-34
December 14, 2007

| | |
|--------|---------------------------------|
| T | Time |
| T | True |
| TACAN | Tactical Air Navigation |
| TAEM | Terminal Area Energy Management |
| TBD | To Be Determined |
| TBS | To Be Specified |
| TEMP | Temperature |
| THC | Translational Hand Controller |
| TLM | Telemetry |
| TVC | Thrust Vector Control |
| UDF | Utility and Data Flow |
| UI | User Interface |
| VDC | Volts dc |
| VU | Vehicle Utility |
| WD | Word |
| WONG | Weight-on-Nose-Gear |
| WOW | Weight-on-Wheels |
| XDUCER | Transducer |
| Y | Yaw |

APPENDIX R CHANGE AUTHORIZATION REFERENCES

R.1 CR REFERENCE SUMMARY

Table R.1-1. lists the paragraphs, tables (T), and figures (F) that have been changed as a result of approved change requests commencing with OI-26 up to the current OI. Changes incorporated prior to OI-26 are listed in the Historical Change Request Summary.

| Table R.1-1. CR Reference Summary | | | |
|-----------------------------------|--------|-----|---|
| Paragraph | CR No. | OI | CR Title |
| N/A | 92307 | 29 | FSSR Format Change - Documentation Only |
| | 93053 | 32 | Expand Effectivity of SCR 92885B to Include OI-32 |
| 1.3-1.(T) | 92103A | 26B | FSSR Parameter Table Upgrade |
| 4.39-1.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 92619A | 30 | Correction CR for CR 92522D |
| 4.39-2.(T) | 91051K | 26B | Streamlined Shuttle GPS Capability |
| | 92025B | 26B | Onorbit TACAN Deletion |
| | 92067D | 27 | Three String GPS Capability |
| | 92144C | 27 | Three String GPS Documentation Cleanup |
| | 90724D | 28 | OPS6 Entry ECAL Automation |
| | 90914C | 28 | Delay MOV MPS Dump/FRCS Dump at MM602 |
| | 92389C | 29 | Spiral HAC in TAEM Area Navigation |
| | 92450C | 29 | Documentation Clean-up for CR 92389 |
| | 92332D | 30 | Add Theta Limits Bracket to MEDS ADI Displays |
| | 92522D | 30 | Overhaul MEDS Composite Flight Instrument Display |
| | 92571B | 30 | Drive HSD MLS, TAC, DRAG and ADTA A/I/F Asterisks at Item Entry |
| | 92619A | 30 | Correction CR for CR 92522D |
| | 93012D | 32 | PASS 6X TRAJ Display Enhancement |
| | 93090E | 33 | Bearing Displays |
| 4.39-3.(T) | 91051K | 26B | Streamlined Shuttle GPS Capability |
| | 92354 | 27 | Delete Erroneous TLM Destinations |
| | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 90914C | 28 | Delay MOV MPS Dump/FRCS Dump at MM602 |
| | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 92389C | 29 | Spiral HAC in TAEM Area Navigation |
| | 92332D | 30 | Add Theta Limits Bracket to MEDS ADI Displays |
| | 92571B | 30 | Drive HSD MLS, TAC, DRAG and ADTA A/I/F Asterisks at Item Entry |
| | 93090E | 33 | Bearing Displays |

| Table R.1-1. CR Reference Summary | | | |
|-----------------------------------|--------|-----|--|
| Paragraph | CR No. | OI | CR Title |
| 4.39-6.(F) | 92619A | 30 | Correction CR for CR 92522D |
| 4.41-1.(T) | 92102B | 26B | GPS I-Load Category Update |
| 4.41-5.(T) | 92102B | 26B | GPS I-Load Category Update |
| 4.53.3 | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.53.5 | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 92512 | 28 | Beep Trim Requirements Cleanup - Documentation Only |
| 4.53-1.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| 4.53-2.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 92355B | 29 | GPC Major Mode to MEDS |
| | 92389C | 29 | Spiral HAC in TAEM Area Navigation |
| | 92332D | 30 | Add Theta Limits Bracket to MEDS ADI Displays |
| | 92522D | 30 | Overhaul MEDS Composite Flight Instrument Display |
| | 93090E | 33 | Bearing Displays |
| | 93100C | 33 | OI-33 Remote Control Orbiter Capability Enhancement |
| 4.53-3.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.53-8.(F) | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| 4.55.2 | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 4.55-2.(T) | 90724D | 28 | OPS6 Entry ECAL Automation |
| | 90914C | 28 | Delay MOV MPS Dump/FRCS Dump at MM602 |
| | 92355B | 29 | GPC Major Mode to MEDS |
| | 92404B | 29 | Preserve MECO Vi, Altitude, & Altitude Rate in MM104 |
| | 92670D | 30 | Abort Improvements to Improve TAL Performance |
| 4.55.3 | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 4.55-1.(T) | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 4.55-2.(T) | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| | 93012D | 32 | PASS 6X TRAJ Display Enhancement |
| 4.55-3.(T) | 92522D | 30 | Overhaul MEDS Composite Flight Instrument Display |
| | 93012D | 32 | PASS 6X TRAJ Display Enhancement |
| 4.57-1.(F) | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 93100C | 33 | OI-33 Remote Control Orbiter Capability Enhancement |
| 4.57-3.(T) | 91051K | 26B | Streamlined Shuttle GPS Capability |
| | 92332D | 30 | Add Theta Limits Bracket to MEDS ADI Displays |
| 4.57-4.(T) | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |

| Table R.1-1. CR Reference Summary | | | |
|-----------------------------------|--------|----|---|
| Paragraph | CR No. | OI | CR Title |
| | 92355B | 29 | GPC Major Mode to MEDS |
| | 93100C | 33 | OI-33 Remote Control Orbiter Capability Enhancement |
| 4.171.4 | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.171-1.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.171-2.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 92157 | 28 | IDD Clarification to Remove Blanks from FSSR Names |
| | 92355B | 29 | GPC Major Mode to MEDS |
| | 92404B | 29 | Preserve MECO Vi, Altitude, & Altitude Rate in MM104 |
| | 92504G | 30 | Alleviate ET Recontact For RTLS 2EO Yellow and Orange Regions |
| | 92510E | 30 | Modification to Maneuver Execute Display |
| | 92522D | 30 | Overhaul MEDS Composite Flight Instrument Display |
| | 92565A | 30 | SE RTLS Increased Pitch Authority Using Forward RCS Jets |
| | 93012D | 32 | PASS 6X TRAJ Display Enhancement |
| 4.171-3.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.199.4 | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 92406 | 28 | DAP Hotstick Downmode Alert and Message - Documentation Only |
| 4.199-1.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 4.199-2.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| | 92510E | 30 | Modification to Maneuver Execute Display |
| 4.199-3.(T) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 5.39-14.(F) | 92885B | 32 | Errata Issue Clean-Up Part I |
| 5.39-15.(1)(F) | 92885B | 32 | Errata Issue Clean-Up Part I |
| 5.39-15.(2)(F) | 92619A | 30 | Correction CR for CR 92522D |
| 5.53-4.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 5.53-8.(F) | 91050C | 28 | Improved Fault Tolerance to Executing Beep Trim Derotation |
| | 92512 | 28 | Beep Trim Requirements Cleanup - Documentation Only |
| 5.55-1.(F) | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 5.55-3.(F) | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 5.55-4.(F) | 92476A | 29 | Documentation Updates to Close SBTC SOP DRs |
| 5.171-7.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |
| 5.199-9.(F) | 90704F | 28 | DAP Hotstick Downmode Alert and Message |

R.2 HISTORICAL CHANGE REQUEST SUMMARY

Table R.2-1. is an historical record of approved change requests incorporated since the initial baseline up to OI-25. Change requests commencing with OI-26 are reformatted and listed in the CR Reference Summary.

| Table R.2-1. Historical Change Request Summary | | |
|--|----|---|
| CR No. | OI | CR Title |
| 2107 | | RTLS Trans Format and Display Rev |
| 2166 | | OFT GN&C Entry Function Update |
| 2182A | | Entry SOP PF Affect Ascent |
| 2254B | | Autoland Cap in OPS 6 |
| 2356 | | Landing Discrete Transitions |
| 2494D | | D/L requirements Level A Entry |
| 12019 | | Standard FSSR Principal Function Interfaces |
| 12040 | | Reduce Orbital RG SOP Process Rate |
| 12042 | | Mod FC Sensor/Controller Initialization |
| 12104 | | 3-Axis RHC SOP Validation in Ascent |
| 12177B | | Interm Dedicated Display Rate Reduction |
| 12210A | | Several RM Changes |
| 12247 | | RHC Deadband Requirements Clarification |
| 12256A | | Aero-Jet DAP Reconnaissance |
| 12266A | | TACAN SOP and RM |
| 12269 | | MSID Corrections to IDD Tables |
| 12313C | | Additional TLM Requirements |
| 12316 | | Switch RM Process Rate Reduction |
| 12336 | | I-Load OFT-1 Mission and LRU Dependent Parameters |
| 12337 | | I-Load OFT-1 Design Dependent Parameters |
| 12338 | | I-Load OFT-1 Baseline Constants |
| 12339 | | I-Load OFT-1 Removed Parameters |
| 12358B | | Manual Throttling Additions |
| 12436B | | SRB Rate Gyro RM |
| 12442A | | Interface Signal Requirements |
| 12443 | | I-Load Entry FACI 5/1 Delivery |
| 12488C | | RHC Processing at 25 Hz |
| 12499E | | Manual Landing SOP |
| 12570A | | Rate Cmd/Att Hold Mode in Ascent |
| 12642 | | 3-Axis RHC SOP Validation |
| 12658A | | Ascent Displays Update |
| 12675A | | Orbit RHC Aft Scaling Fix |

| Table R.2-1. Historical Change Request Summary | | |
|--|----|--|
| CR No. | OI | CR Title |
| 12684 | | RHC Roll Breakout Deadband |
| 12685 | | ADTA SOP Cleanup |
| 12720A | | CHG Software Softstop Values 3-Axis RHC |
| 12738 | | FC SOP I-Load Designations |
| 12914A | | WOW-WONG Commands for Entry |
| 12933A | | Capability Panel Trim Switch |
| 12935 | | ADTA SOP I-Load Update |
| 12966 | | RHC Processing at 25 Hz |
| 12975 | | 3-Axis RHC Detent/Trans DAP |
| 12868A | | I-Load Change From Mode Team Actions |
| 12910A | | PCMMU Toggle Buffer Management |
| 12912A | | I-Load Deletions/Additions |
| 12937 | | Elevon Trim Schedule for OFT |
| 12948 | | Add Auto Maneuver Capability |
| 12951B | | Universal Function I-Load Changes |
| 12993 | | I-Load Version FACI |
| 12994 | | I-Load OFT-1 FACI Update |
| 19010 | | I-Load MSID Assign SCB Baseline |
| 19022 | | MPAD I-Load Paper Baseline 9/21 |
| 19038 | | RES I-Load Data Base Discrepancies |
| 19054 | | Modifications to 9/4 and 12/11 I-Load Baseline |
| 19100 | | Interim Change Requests for PCN 1 |
| 12808 | | Revise RHC Softstop |
| 12920B | | GRTLS DAP Lashup |
| 12950 | | 3-Axis RHC Scheduling in Ascent |
| 19012 | | DOC Changes for WOW DLMA Flag |
| 19014A | | On-Orbit Software Requirements Document |
| 19039C | | Ascent/Entry Structural PTI's |
| 19069A | | Resolution of I-Load Ambiguities |
| 19078A | | RTLS TAEM Guidance Navdad/Default |
| 19089 | | Delete Multiple MSID's in I-Load |
| 19105 | | ADTA SOP Nonstandard Atmosphere |
| 19114 | | Cancel REV RHC Softstop |
| 19160 | | RHC TRIM Process Rate Cleanup |
| 19161A | | Estimated Beta |
| 19166 | | Yaw Detent Change for RHC |
| 19065 | | I-Load Data Base Discrepancies |

| Table R.2-1. Historical Change Request Summary | | |
|--|----|--|
| CR No. | OI | CR Title |
| 19300 | | FSSR Update PCN B |
| 19085A | | Add Commfault Logic |
| 19056 | | Equivalent Airspeed to Ground Speed Indicator on AMI During Rollout |
| 19334 | | Latch Air Data Calculation |
| 19341 | | Execution Rate of AA |
| 19346 | | Clarification of Landing SOP |
| 19406 | | AFT THC Transformation |
| 19430 | | AFT RHC Transformation Clarification |
| 19362 | | Clarification SBTC Station |
| 12981D | | On-Orbit Flight Control |
| 19455 | | Measurement Attribute |
| 19500 | | FSSR Update PCN 1 |
| 19578 | | ADTA Pressure Alt Rate Initialization |
| 19367A | | Ascent/GRTLS RHC Detent Addition |
| 19380 | | Requirements Conflict in BF Slew Command SOP |
| 19504 | | 3-Axis RHC Scheduling in Ascent and RTLS |
| 19653 | | Air Data Initialization |
| 19700 | | FSSR Update 4 |
| 12328A | | Event Light Modification |
| 19367A | | Deleted By 29340A |
| 19467B | | I-Load Corrections to IDB 3 |
| 19550 | | Documentation Change To Reflect CR 19220A |
| 19627B | | CRT Message Annunciation After Weight on Main Wheels (STS 2 and Subsequent) |
| 19693 | | Elimination of 3-Axis RHC From MM101 |
| 19811A | | RHC Outer Detent Values Reduction (STS 1 Only) |
| 19900 | | FSSR Update PCN3 to Revision B |
| 19875 | | Resolution of Requirement Conflict Between P.F. G4.35 and 4.216 |
| 19878A | | Three-Axis RHC Application Correction |
| 19984A | | Air Data SOP Transition Logic Change |
| 19992B | | Decouple NAV From Air Data During Mach Jump |
| 29003A | | Alpha/Mach Indicator Update Rate Change to Vert Sit 1 Display (STS-1) |
| 29005B | | Automatic ADS/Navdad Switch by Altitude |
| 29006A | | Unlimited Air Data System Angle of Attack |
| 290043A | | CR 19223 and 19360A Incorporated Into Orbiter RG SOP |
| 29161A | | OPS Dependence of Air Data Parameters |
| 29166A | | Non-Standard Atmosphere Correction |

| Table R.2-1. Historical Change Request Summary | | |
|--|----|--|
| CR No. | OI | CR Title |
| 29170A | | STS-3 Required Approach/Land Guidance Modifications |
| 29186 | | Air Data SOP I-Load Update |
| 29300 | | FSSR Update PCN4 to Revision B |
| 29340A | | Delete CR 19367A – Dual RHC Detent |
| 29370 | | Revision TO CR 29005B – Automatic ADS/Navdad Switch by Altitude |
| 29371A | | Air Data SOP – Communication Fault Protection for Display Calculations |
| 29392B | | Revision to CR 19992B to Correct Downlist Name |
| 29444C | | Integrated Controls Display (Reference Only) |
| 39087A | | Head up Display (HUD) |
| 39132C | | Create Secondary Throttle Set (Reference Only) |
| 39410 | | RHC Outer Detent Value Change |
| 39450 | | CR Implementation Baseline (1037) |
| 39615A | | Correct RHC Software Stop Logic |
| 39663 | | Clarify CR 19406 (THC_TRANS) |
| 39760 | | Alpha Limit Protect in OPS-3 |
| 39365F | | HUD Proc I/O Cleanup |
| 39815A | | Automated “PTI” |
| 39910C | | Inhibit FCS SAT MSG |
| 59135 | | SPI Processing-Speed Brake CMO (IDD Only) |
| 59165 | | Air Data SOP Cleanup |
| 59298A | | Clarify PSC* in Air Data SOP |
| 59113A | | KSC/EAFB June – Sept I-Loads (Reference Only) |
| 59114A | | KSC/EAFB Oct May I-Loads (IL Reference Only) |
| 59165 | | Air Data SOP Cleanup |
| 59298A | | Clarify PSC* in Air Data SOP |
| 59756A | | Correct CR 39861A – ADTA SOP |
| 59959 | | I-Load Scrub: AUTOLAND |
| 69098F | | WOWLON/Rollout Set Premature |
| 69125H | | CR Implementation Baseline – Sept 1983 |
| 69550B | | CR Implementation Baseline – March/April 1984 |
| 69600D | | OMS Guidance Improvements (3) |
| 69602 | | Clarify RHC Soft Stop Logic |
| 69955 | | Correct CR 69098F |
| 79067 | | Modified RTLS LO2 Auto Dump (IDD ONLY) |
| 79079B | | Modified OI7 MPS Dump |
| 79157 | | Software Fix for Hydraulic Brake Lockup (51C and Subsequent) |
| 79158C | | Forward RCS Dump (Reference Only) |

| Table R.2-1. Historical Change Request Summary | | |
|--|----|---|
| CR No. | OI | CR Title |
| 79338A | | Change of EH/ASO PF Manager |
| 79471 | | Correct Flight Control Switch Processing |
| 79499 | | FSSR Update No. 5 |
| 79463A | | Nose Wheel Position SOP |
| 79478B | | Nosewheel Position SOP Cleanup |
| 79564A | | Landing SOP K-Load Update (I-Load Only) |
| 79588A | | OI6 GMEM for FOFS SRB RGA'S |
| 79604 | | Throttle Sealing Update (I-Load Only) |
| 79640A | | Nose Wheel Position SOP Requirements Cleanup |
| 79673 | | T_WOW Update |
| 79752A | | GMEM for FOFS SRB RGA's |
| 79780 | | Nosewheel Fail Safe W/2 String C.F. |
| 79790A | | CR Implementation Baseline – November 1985 |
| 79880A | | Correct THC Transport Lag, Execution Rate |
| 79885D | 20 | Air Data Calc. W/O Spec. 51 |
| 79935H | | SRB RGA Rechannelization |
| 79962F | | Entry/GRTLS DAP OI-8C Scrub |
| 89120A | | Load Relief Modification |
| 89215 | | FSSR Update No. 6 |
| 89301C | | Clarification of MM 603 and MM 305 Guidance Initiation Criteria |
| 89430 | | OI-8C Implementation of CR 89113B (MM 305/603 Vent Door Update) |
| 89461A | | FSSR STS 83-0002B Errata Baseline |
| 89558A | | OI-8C FCS Scrub Clean-up |
| 89752A | | Errata STS 83-0015B |
| 89823C | 20 | Uplink IMU/RGA/AA Constants |
| 89863 | | Correct Threshold and Trim CMD Process |
| 89889H | 20 | Improved Nosewheel Steering Software |
| 89921C | 20 | Closed loop PRCS Mode |
| 89967A | | Update RHC Validation Process |
| 89990E | 21 | Single Engine Auto Contingency Abort |
| 89995 | 20 | Clean-up 79885D – Air Data Calc. W/O Spec. 51 |
| 90060A | | Weight on Nosewheel Proximity Sensor Disagree Timer Change |
| 90094C | 21 | I-load to K-load Change |
| 90102D | 21 | LDG Gear Extension Isolation Valve |
| 90112E | 21 | Extended Duration Orbiter WOW Sensing Upgrades |
| 90254 | 21 | CR 90094 K-load Requirements Correction |
| 90325A | 21 | Processing and PRL Requirements C/U for 90102D |

| Table R.2-1. Historical Change Request Summary | | |
|--|----|--|
| CR No. | OI | CR Title |
| 90374C | 21 | Automated FSSR Constants |
| 90400 | 20 | Manual SBTC Lamp Discrete Documentation Correction |
| 90506C | 25 | Initialization of NWS Difference Filter on Changing Channels |
| 90690A | 24 | Deletion of EQTN MSID Column from K-load FSSR Tables |
| 90705H | 25 | 3 Engines Out Auto Contingency |
| 90790 | 24 | Add Memory Configuration to the FSSR I-Load Tables |
| 90814C | 24 | Add Description of Database Generated FSSR Parameter Tables |
| 90881A | 25 | FSSR STS83-0001 Documentation Changes |
| 90896 | 24 | FSSR STS83-0015 Doc Changes |
| 90900D | 24 | FSSR-9 Orbit Flight Control Documentation Changes |
| 90964 | 25 | Interface Clarification for 3 Engines Out – CR 90705H |
| 90966A | 24 | Deletion of the Qualifier from the FSSR I-Load Tables |
| 91066D | 25 | Standardize the FSSR Correlation Tables |
| 92027B | 25 | TDMS-2 Required FSSR Changes |

This page intentionally left blank.