

SPAR - BRAMPTON (SSS)  
9445 AIRPORT RD

## Critical Items List

SRMS

BRAMPTON ONTARIO L6S4J3

CIL Ref#: 2671

Revision: 0

FMEA Rev: 1

System: SRMS

Subsystem: ELECTRICAL SUB-SYSTEM

Assembly Desc: Servo Power Amplifier

Part Number(s): 51140F1177-3

51140F1177-5

Item:

Function: Digital Interface Assembly

Receives and loads command data to CPU. Generates position encoder clock and sync signals, processes position encoder data and external flags and assembles return data for transmission to MCIU.

Failure Mode: Erroneous RDW2 data.

HW Func. Screen Failures

Criticality: 2 1R

Mission Phase: Orbit

Cause(s): Digital Interface Assembly

BITE and BITE verification bits failed to hardwired values.

Loss of return data word 2 BITE data.

Loss of return data word 2 data for high byte.

Loss of return data word 2 data for low byte.

Loss of return data word 2 high byte data.

Loss of return data word 2 low byte data.

One of RDW2 shift register MUX's failed to channel B (shift).

Return data word 2 high byte single bit failed active.

Return data word 2 low byte data is set to all 0's.

Return data word 2 low byte data single bit failed active.

Failure effect on  
unit/end item:

One or more bits of SPA return data word #2 is corrupt. Shoulder brace release flag, EEEU BITE flag, motor current word and all SPA BITE and BITE verification data may be corrupt. Return data word BITE test will detect incorrect read back of the return data word 2 shift register when 0FF0 or F00F test is performed but may be unable to correctly set bits 7,8 and 15 of RDW2 to '000' to provide "Loss of BITE" annunciation. Any SPA BITE or BITE verification may be annunciated.

Worst Case: Loss of mission. Loss of computer supported modes.

Redundant Paths: Direct Drive.

Backup Drive.

Retention Rationale

The SPA board is fabricated using Surface Mount Technology (SMT). This is a PWB assembly technology in which the components are soldered to the solder pads on the surface of the PWB. The significant advantage of this technology is to enable the parts on the board to be more densely packed, to reduce the overall volume and weight of the assembly.

The assembly process is highly automated. The parts are mounted on the boards using a computer controlled "pick and place" machine. The subsequent soldering operation is performed using a belt furnace, in which the time and temperature thermal profile that the PWB assembly is exposed to is tightly controlled and optimized to ensure proper part soldering attachment. The assembly is manufactured under documented procedures and quality controls. These controls are exercised throughout the assembly, inspection and testing of the unit. This inspection includes workmanship, component mounting, soldering, and conformal coating to ensure that it is in accordance with the NHB 5300 standards.

The SMT line used for the SPA PWB assembly has undergone a full qualification program, and assemblies produced on this line are used in other space programs.

The circuit board design has been reviewed to ensure adequate conductor width and separation and to confirm appropriate dimensions of solder pads and of component hold provisions. Parts mounting methods are controlled in accordance with MSFC-STD-154A, MSFC-STD-136 and SASD 2573751. These documents require approved mounting methods, stress relief and component security.

**Test:**

**QUALIFICATION TESTS** - The SPA is subjected to the following qualification testing:

**VIBRATION:** Each axis of the QM is subjected to Flight Acceptance Vibration Test (FAVT), Qualification Acceptance Vibration Test (QAVT), and Qualification Vibration Tests (QVT) in accordance with the SPA Vibration Test Procedure (826586). The level and duration for FAVT is as per Figure 6 and Table 2 of 826586; the level and duration for QAVT is as per Figure 7 and Table 2 of 826586; the level and duration for QVT is as per Figure 8 and Table of 826586. At the end of the three successive random vibration test in each axis, both directions (+/-) of each of the axis is subjected to a shock pulse test as per Figure 9 of 826586.

**THERMAL/VACUUM:** QM TVAC Test is in accordance with Figure 5 of the SPA TVAC Test Procedure (826588), with full Functional/Parametric Test performed at levels of +60 degrees C and -36 degrees C, and non-operating at -54 degrees C. The Qualification vacuum levels during TVAC is  $1 \times 10^{-6}$  torr or less. The total test duration is 7 1/2 cycles. The QM SPA is subjected to a minimum of 1000 hours of life testing and 1000 power On-Off cycles.

**EMC:** The QM is subjected to EMC Testing (tests CE01/CE03, CE07, CS01, CS02, CS06, RE02, RS02, and RS03) in accordance with the SPA EMC test Procedure (826477) based on MIL-STD-461A.

**UNIT FLIGHT ACCEPTANCE TESTS** - The FM SPA is subjected to the following acceptance testing:

**VIBRATION:** FM Acceptance Vibration Test (AVT) in accordance with the SPA Vibration Test Procedure (826586), with level and duration as per Figure 6 and Table 2 of 826586.

**THERMAL/VACUUM:** FM TVAC Test is in accordance with Figure 6 of the SPA TVAC Test Procedure (826588), with levels of +49 degrees C and -25 degrees C for a duration of 1 1/2 cycles. The vacuum levels during Acceptance TVAC Test is  $1 \times 10^{-5}$  torr or less.

**JOINT SRU TESTS** - The SPA is tested as part of the joints (ambient and vibration tests only). The ambient ATP for the Shoulder Joint, Elbow Joint, and Wrist Joint are as per ATP.2001, ATP.2003, and ATP.2005 respectively. The vibration test for the Shoulder Joint, and Elbow or Wrist Joint are as per ATP.2002, ATP.2004 and ATP.2006 respectively. Through wire function, continuity and electrical isolation tests are performed per TP.283.

**MECHANICAL ARM REASSEMBLY** - The SPA's/Joints undergo a mechanical arm integration stage where electrical checks are performed per TP.2007.

**MECHANICAL ARM TESTING** - The outgoing split-arm is configured on the Strongback and the Manipulator Arm Checkout is performed per ATP.1932.

**FLIGHT CHECKOUT:** PDRS OPS Checkout (all vehicles) JSC 16987.

**Inspection:**

Units are manufactured under documented quality controls. These controls are exercised throughout design procurement, planning, receiving, processing, fabrication, assembly, testing and shipping of the units. Mandatory inspection points are employed at various stages of

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Unit Pre-Acceptance Test inspection, which includes an audit of lower tier inspection completion, as built configuration verification to as design etc (mandatory inspection point). A unit Test Readiness Review (TRR) which includes verification of test personnel, test documents, test equipment calibration/validation status and hardware configuration is convened by QA in conjunction with Engineering, Reliability, Configuration Control, Supplier as applicable, and the government representative, prior to the start of any formal testing (Acceptance or Qualification). Unit level Acceptance Testing (ATP) includes ambient performance, thermal and vibration testing (Spar/government rep. mandatory inspection point).

Integration of unit to Joint SRU - Inspections include grounding checks, connectors for bent or pushback contacts, visual, cleanliness, interconnect wiring and power up test to the appropriate Joint Inspection Test Procedure (ITP). Joint level Pre-Acceptance Test Inspection, includes an audit of lower tier inspection completion, as built configuration verification to as design etc. Joint level Acceptance Testing (ATP) includes ambient and vibration testing (Spar/government rep. mandatory inspection point).

Mechanical Arm Reassembly - the integration of mechanical arm subassemblies to form the assembled arm. Inspections are performed at each phase of integration which includes electrical checks, through wiring checks, wiring routing, interface connectors for bent or pushback contacts etc. Mechanical Arm Testing - Strongback and flat floor ambient performance test (Spar/government rep. mandatory inspection point).

OMRSD Offline: Power-up arm. Verify no ABE communication failures or BITE errors. Also operate End Effector and check EEEU BITE.

OMRSD Online None.  
Installation:

OMRSD Online Power-up arm. Verify no ABE communication failures or BITE errors. Also operate End Effector and check EEEU BITE.  
Turnaround:

Screen Failure: A: Pass  
B: Pass  
C: Pass

Crew Training: The crew will be trained to always observe whether the arm is responding properly to commands. If it isn't, apply brakes.

Crew Action: Select Direct Drive. Single/Direct Drive switch should be pulsed to maintain proper rates.

Operational Effect: Computer supported modes are lost. Autobrakes. Direct Drive and Back-up are available. BITE Override is available to regain computer supported modes.

Mission None.  
Constraints:

### Approvals:

Functional Group	Name	Position	Telephone	Date Signed	Status
Engineer	Hiltz, Michael	Systems Engineer	4634	15Oct97	Signed
Reliability	Molgaard, Lena	Reliability Engineer	4590	15Oct97	Signed
Program Management Office	Taplin, Ron	Technical Manager	4766	15Oct97	Signed
Subsystem Manager	Glenn, George	RMS Subsystem Manager	(281) 483-1516	24Mar98	Signed
Technical Manager	Peck, John	Technical Manager (JSC)	713-483-1264	31Mar98	Signed

RETRY + MISSION RESUME COM, DAVID

RMS JSC ENGINEER

(281) 483-1516 27 MAR 98 David A. Co