

SPAR - BRAMPTON (SSS)  
9445 AIRPORT RD

## Critical Items List

SRMS

BRAMPTON ONTARIO L6S4J3

CIL Ref#: 2592

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: Central Processing Unit Assembly

Provides hardware and software necessary to implement servo control loops, control operation of the Analog I/F, Digital I/F and MDA boards and communicate with the MCIU. Provides PLL and frame sync BITE as well as a hardware watchdog timer to monitor health of microcomputer itself.

Failure Mode: One of check bits to EDAC fails

	HW	Func.	Screen	Failures
Criticality:	2	1	R	

Mission Phase: Orbit

Cause(s): Central Processing Unit Assembly

One of check bits to EDAC fails.

Failure effect on  
unit/end item:

If check bit fails high, BITE Verification test will result in an NMI being generated and the CPU will halt. Autobrakes. Loss of Computer Supported Modes. Direct Drive remains available. If check bit fails low, no effect since EDAC will correct for single bit error.

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

Redundant Paths: Direct Drive.  
Backup Drive.

### Retention Rationale

Design:

The Intel 80186 microprocessor is used in this design. This device, designed for use in conjunction with its corresponding high reliability support devices (EPROM, SRAM) comprises a processor kernel proven in many high reliability applications.

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 to 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

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**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 Qualificatio 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 fabrication, assembly, and test. Government source inspection is invoked at various control levels.

EEE parts inspection is performed as required by SPAR-RMS-PA.003. Each EEE part is qualified at the part level to the requirements of the applicable specification. All EEE parts are 100% screened and burned-in, as a minimum, as required by SPAR-RMS-PA.003, by the supplier. DPA is performed as required by PA.003 on a randomly selected 5% of parts, maximum 5 pieces, minimum 3 pieces for each lot number/code of parts received. All cavity devices are subjected to 100% PIND. Wire is procured to specification MIL-W-22759 or MIL-W-81381 and inspected and tested to NASA JSCM8080 Standard Number 95A.

Receiving inspection verifies that all parts received are as identified in the procurement documents, that no physical damage has occurred to parts during shipment, that the receiving documents provide adequate traceability information and screening data clearly identifies acceptable parts.

Parts are inspected throughout manufacture and assembly as appropriate to the manufacturing stage completed. These inspections include:

Printed circuit board inspection for track separation, damage and adequacy of plated through holes, component mounting inspection for correct soldering, wire looping, strapping, etc. Operators and inspectors are trained and certified to NASA NHB 5300.4(3A-1) Standard. Conformal coating inspection for adequate processing is performed using ultraviolet light techniques. P.C. Board installation inspection includes checks for correct board installation, alignment of boards, proper connector contact mating, wire routing, strapping of wires etc. Post P.C. Board installation inspection includes cleanliness and workmanship (Spar/government rep. mandatory inspection point).

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).

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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:** Cannot use computer supported modes. Autobrakes. Direct Drive and Backup available. Arm will not stop automatically if failure of the auto brakes system has previously occurred. Brakes can be applied manually.

**Mission Constraints:** None.

### 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

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