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Gravity Probe B Relativity Mission

HV CAPACITOR SCREENING PROCEDURE FOR THE GYROSCOPE SUSPENSION SYSTEM (GSS) HV AMP/BRIDGE (HVA) BOARD

GP-B Procedure
P0688 Rev -

Prepared by: William Bencze RE, Gyroscope Suspension System (GSS) Group	Date
Approved by: William Bencze GP-B Payload Electronics Manager	Date
Approved by: Dorrene Ross GP-B Quality Assurance	Date

Table of Contents:

1.0 Revision History

Rev Level	Comments/notes	Date	Revised By
-	First release of this procedure	15-Jun-2000	WJ Bencze

2.0 Scope:

This procedure details the required steps to screen and qualify commercial high voltage ceramic NPO capacitors for flight use on the GSS HVA/Bridge card.

This procedure subjects a number of candidate components to a set of thermal and electrical stress tests. Components which successfully pass these tests are considered qualified for flight use as part of the GSS HVA/Bridge assemblies. These tests verify the salient requirements for these high voltage capacitors, as outlined in the NASA/GSFC document S-311-P-15.

This procedure also details the matching and kitting operations needed for the assembly of the HVA/Bridge board, PN 8A01879.

3.0 Reference Documents

3.1. NASA/Goddard Space Flight Center document S-311-P-15, Rev D: “Capacitors, fixed ceramic monolayer, dielectric, high voltage, for space use”

4.0 Test Facilities

4.1. HEPL Room 127, Stanford University. (high-temp burn-in.)

4.2. Battel Engineering laboratory, Scottsdale, Arizona. (thermal cycle chamber)

5.0 QA Provisions:

5.1. This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer (D. Ross) and the ONR representative (E. Ingraham) shall be notified 24 hours prior to he start of this procedure. Since this test will be performed at various locations over the course of approximately 2 weeks, the GSS RE (or his designee) shall keep QA informed as to the progress of these tests. QA may monitor the execution of all or part of this procedure should they elect to do so.

Date/time:_____	Date/time:_____
GP-B QA (D. Ross)	ONR (E. Ingraham)

5.2. Upon completion of this procedure, the GSS manager and the GP-B QA manager shall certify her/his concurrence that the procedure was performed and accomplished in accordance with the prescribed instructions by signing and dating his approval at the end of this procedure.

6.0 Test Personnel

This test procedure is to be conducted only by the following personnel:

6.1. William Bencze

6.2. Son Tran

6.3. Jennifer Bower.

6.4. Steve Battel, Battel Engineering.

6.5. Jay Dusenbury

7.0 General Instructions

7.1. Redlines can be initiated by the certified test personnel listed in Section 6.0 and must be approved by QA.

7.2. Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.

7.3. Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

7.4. Only the following persons have the authority to exit/terminate this test or perform a retest: Certified test operators listed in Section 6.0 and GP-B QA.

7.5. In this document, “Perform Flight S/W system test commands:” means to prepare the test system software as described in P0670 Board-Level Test Software Operational Procedure, and then issue the listed commands according to the procedure described in P0670.

8.0 Hardware Safety Requirements:

8.1. Ensure that power is removed from cable assemblies before connecting or disconnecting cable connectors.

8.2. Where applicable, examine all mating connectors before attempting to mate them. Remove any foreign particles. Look for any damaged pins or sockets. Do not force the coupling action if excessive resistance is encountered. Ensure that key-ways are aligned when mating connectors.

9.0 Equipment Pretest Requirements:

None.

10.0 Additional Test Equipment

The following support hardware, test equipment, or software will be used and the applicable information for the instruments shall be recorded below. Hand-written additions to this list as needed.

Equipment Description	Make	Model	SN	Cal Due
1. Capacitance Meter	BK	878		
2. HV power supply (5kV)	SRS			
3. Digital Multimeter	Fluke			
4. Thermal stress chamber (at Battel Engineering)				
5. Laboratory oven				
6. Thermocouple meter	Omega			
7. Type K thermocouple	Omega		-	-
8. 4ea capacitor test fixtures	Stanford	-	-	-

11.0 Components under test:

The following components shall be tested by this procedure:

Manufacturer: Maida Development Co. (20 Libby St, Hampton, VA 23663)
Description: NPO monolayer ceramic capacitor, 3 kV, various capacitance values.

Procured under Stanford PO U3AD-D88390 (18 Nov 1994) as commercial parts.

Part numbers to be tested:

Full PN	Device Marking	Qty
D6354C0G101J3KV	100J	100
D7054C0G301J3KV	300J	100
D6654C0G201J3KV	200J	150
D73C0G110J3KV	11J	80
D6154C0G150J3KV	15J	40
D60C0G759C3KV	7.5C	40
D60C0G509CJ3KV	5C	40
D60C0G309CJ3KV	3C	40

12.0 Qualification Procedure:

The component part numbers, values, and serial numbers are recorded on the data sheets which are appended to this procedure. All data required for these tests shall be recorded on these data sheets. The operations for the individual test items are given below:

12.1. Initial 100% Visual Inspection

Under 3X to 10X magnification, inspect the surface of the capacitor, looking for any cracks in the yellow epoxy coating. Pay particular attention to

1. The areas where the leads exit the capacitor body.
2. The raised in the outer coating where the leads contact the capacitor disk.
3. The edge of the disk.

The capacitor shall fail this test if any cracks are found. Remove the capacitor from the population and draw a line through the remainder of the test items on the data sheet. Bag and tag the failed capacitor and return it to the GSS RE.

Task completed by: _____

Date/Time: _____

12.2. Initial Electrical Characterization:

Using the calibrated capacitance meter noted in section 10, measure and record the following information:

1. The capacitance value.
2. The capacitor's dissipation factor (D) (if the meter reads "---", record it as 0.000)
3. The capacitor's lot date code (LDC). This is printed on the capacitor below the "NPO3KV" notation.

Task completed by: _____

Date/Time: _____

12.3. Thermal Cycle:

Subject the capacitors to the following thermal profile. Starting from ambient,

1. Execute 10 cycles between –50 C ± 5 C and +85 C ± 5 C.
2. Soak at temperature extremes: minimum 30 mins
3. Transition time between temperature extremes: maximum 90 mins.

(This operation to be performed at Battel Engineering by Steve Battel or his designee; see sheets attached to the traveler for additional documentation)

Task completed by: _____

Date/Time: _____

12.4. Intermediate 100% Visual Inspection

Under 3X to 10X magnification, inspect the surface of the capacitor, looking for any cracks in the yellow epoxy coating. Pay particular attention to

1. The areas where the leads exit the capacitor body.
2. The raised in the outer coating where the leads contact the capacitor disk.
3. The edge of the disk.

The capacitor shall fail this test if any cracks are found. Remove the capacitor from the population and draw a line through the remainder of the test items on the data sheet. Bag and tag the failed capacitor and return it to the GSS RE.

Task completed by: _____

Date/Time: _____

12.5. Burn-in at high temperature, high voltage:

1. Tack solder the capacitors onto the flea clips on the burn-in fixture. (See attachment 1 for schematic diagram)
2. Load the fixtures into the laboratory oven.
3. Set oven temperature to 125 C ± 5 C.
4. Set HV power supply to 3550 V ± 20 V; set the current trip level on the power supply to 1 mA.
5. Apply HV to the burn-in fixture.
6. Burn-in capacitors for 96 hours –0/+12. Record oven temperature and power supply current every 12 hours in the table below:

Line	Date	Time (24-hr)	Temp (°C)	HV Current (mA)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

Should the HV power supply trip or the HV current exceed 0.5 mA at any monitoring time during the test, terminate the test (turn off the oven, HV) and notify QA and the GSS RE.

Task completed by: _____

Date/Time:_____

12.6. Final 100% Visual Inspection

Under 3X to 10X magnification, inspect the surface of the capacitor, looking for any cracks in the yellow epoxy coating. Pay particular attention to

1. The areas where the leads exit the capacitor body.
2. The raised in the outer coating where the leads contact the capacitor disk.
3. The edge of the disk.

The capacitor shall fail this test if any cracks are found. Remove the capacitor from the population and draw a line through the remainder of the test items on the data sheet. Bag and tag the failed capacitor and return it to the GSS RE.

Task completed by: _____

Date/Time: _____

12.7. Final Electrical Characterization:

Using the calibrated capacitance meter noted in section 10, measure and record the following information:

1. The capacitance value.
2. The capacitor's dissipation factor (D) (if the meter reads "---", record it as 0.000)
3. Compare the final values of C and D to the initial values, Variations of up to ± 10% of the original values is permissible. *Should any of the vary more than ± 10%, remove failed capacitor from the population, bag and tag it and return it to the GSS RE*.

Task completed by: _____

Date/Time: _____

13.0 Parts Kitting

Parts for the HVA/Bridge board are to be kitted according to the following component value and matching requirements:

Component ID:	Nominal value	Matched within
C1, C12	200pF ± 2 pF	0.5 pF
C2, C13	200pF ± 2 pF	0.5 pF
C10, C20	200pF ± 2 pF	0.5 pF
C6, C7, C15, C16	100pF ± 2 pF	0.5 pF
C9, C17	300pF ± 2 pF	0.5 pF
C5, C14	300pF ± 2 pF	0.5 pF
C48, C59	11pf ± 1pF	0.5 pF
SAT, 2 ea.	3 pF ± 0.5 pF	N/A
SAT, 2 ea.	5 pF ± 1 pF	N/A
SAT, 2 ea.	7.5 pF ± 1 pF	N/A
SAT, 2 ea.	11 pF ± 1 pF	N/A
SAT, 2 ea.	15 pF ± 1 pF	N/A

1. 15 kits are required.

2. Select components which meet the above matching criteria based on the final value of the capacitance measurement taken in section 12.7.

3. Record the serial numbers of the various capacitors used in each kit on the following kit list data sheet.

4. Package each capacitor in its own separate plastic bag. Attach a label to the outside of the bag with the following information (hand-written information on the label is permissible)

   A. Kit number (eg: Kit #1)
   B. Component ID (eg: C12)
   C. Component P/N (eg: D6354C0G201J3KV-635)
   D. Component Serial number
   E. Component Value (eg: 200.3 pF)

5. Package each set of components in another plastic bag, with a an easily visible label indicating the kit number of the package.

Task completed by: _____

Date/Time: _____

Completion of Procedure:

I certify that this procedure was performed in whole and that the data recorded above is complete and accurate.

Test Engineer		Date	

This is to certify that the information obtained under this test procedure is as represented and the documentation is completed and correct.

GSS Representative		Date	
Quality Assurance		Date	

P0688 – Kit list for selected and matched HV capacitors (keep with body of P0688 document)

Record serial numbers of each of the capacitors placed in each kit in the spaces below:

Notes:
1. Cxx designated components are used in the initial assembly of the PWA.
2. SAT designated components are used on an as-needed basis during board.

Kit	C1	C12	C2	C13	C10	C20	C6	C7	C15	C16	C9	C17	C5	C14	C48	C59	SAT1 3	SAT2 3	SAT1 5	STA2 5	SAT1 7.5	SAT2 7.5	SAT1 11	SAT2 11	SAT1 15	SAT2 15
1																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										

Task completed by: _____

Date/Time:_____

P0688 – HV capacitor qualification operations data sheet **Capacitor PN: _____**

Operator: Fill in serial numbers in far left column, initial and date each test as it is completed for each of the components (a single initial/date for a complete column is acceptable)

List only one capacitor PN per page.

Step:	**11.1**	**11.2**			**11.3**	**11.4**	**11.5**	**11.6**	**11.7**		**Pass/Fail**
SN:	Visual	Cap (pF)	Diss	LDC	Thermal cycle	Visual	Burn-in	Visual	Cap (pF)	Diss	

(duplicate as needed) Page ____ of _____