RBSP EFW
Instrument Requirements Verification Matrix Document

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RBSP EFW Instrument Requirements Verification Matrix Document, RBSP_EFW_SYS_017G

ID	Req. Title	Subject	Priority	Requirement Body or Section Heading	Description / Clarification	Source Type	Rationale	*Impacts / Effects*	*Verification Method*	*Description of where Verification Met*	*Document / Procedure No.*	*Test Report showing Verification*	*Requirement Fully Met*
				3 Functional Requirements									
				3.1 Functional, performance and general design requirments									
EFW-1	**Instrument Design life**	Each EFW Instrument	shall	be designed for a total lifetime duration of 2 years plus 60 days.		Inherited	IPLD - 14	EFW-137	A	Analyses of limited life items and consumables, parts radiation tollerance, parts reliability	MA-002, MA-005, SE-007	MA-002, MA-005, SE-007, Travelers	Yes
EFW-200	**Instrument Calibration**	Each EFW Instrument	shall	be calibrated prior to launch, and be designed to accommodate additional in-flight calibration		Inherited	IPLD - 506	RBSP_EFW_TE_001, EFW-29	T	Cal, FSW CPT, Instrument CPT	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011 Procedure, RBSP_EFW_FSW_024, RBSP_EFW_INT_012	Science Calibration Report RBSP_EFW_FSW_020C, Instrument CPT Report	Yes
EFW-6	**Instrument Orbit Inclination Operability**	Each EFW Instrument	shall	be capable of operating in an orbit with an inclination of 10° ± 0.25°.		Inherited	IPLD - 120	EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	A	Environmental analysis, Lower level requirement verification	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Yes
EFW-7	**Instrument Orbit Perigee Operability**	Each EFW Instrument	shall	be capable of operating in an orbit where perigee altitude is between 500 km and 675 km.		Inherited	IPLD - 184	EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	A	Environmental analysis, Lower level requirement verification	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Yes
EFW-8	**Instrument Orbit Apogee Operability**	Each EFW Instrument	shall	be capable of operating in an orbit where apogee altitude is between 30,050 km and 31,250 km.		Inherited	IPLD - 183	EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	A	Environmental analysis, Lower level requirement verification	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Yes
EFW-201	**Instrument Accommodation of Observatory Sun Off-Point Angle (Component)**	Each EFW Instrument	shall	shall be capable of collecting required science measurements under the condition where the off-pointing angle between the spin axis of each observatory and the Sun-Earth line during nominal operations does not exceed 25 degrees North or South of the ecliptic plane, or 25 degrees East or West in the ecliptic plane, where "north" and "south" are with respect to an ecliptic coordinate system.	Note: "North" and "South" are not specified with respect to a geographic coordinate system	Inherited	IPLD - 121	EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	A	Environmental analysis, Lower level requirement verification	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Yes
EFW-202	**Instrument Accommodation of Observatory Sun Off-Point Angle (Composite)**	Each EFW Instrument	shall	be capable of collecting required science measurements under the condition where the total off-pointing angle between the spin axis of each observatory and the Sun-Earth line during nominal operations is greater than 15 degrees, and does not exceed 27 degrees.	Spin axis assumed to be pointing into the solar hemisphere.	Inherited	IPLD - 177	EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	A	Environmental analysis, Lower level requirement verification	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Complete once EFW-136, EFW-209, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52 are verified	Yes
EFW-9	**Instrument Accommodation of Observatory Operational Spin Rate Range**	Each EFW Instrument	shall	be capable of operating nominally within an observatory spin rate range of no less than 4 rpm and no more than 6 rpm.	Nominal spin rate is 5rpm	Inherited	IPLD - 185	EFW-119, RBSP_EFW_SPB_001	A,T	FSW CPT, Key Reel Characterization	RBSP_EFW_FSW_024, RBSP-SPB-PRO-111	RBSP_EFW_FSW_020C, RBSP-SPB-PRO-111	Yes
EFW-10	**Instrument Accommodation of Observatory Selected Operational Spin Rate**	Each EFW Instrument	shall	be capable of collecting required science measurements at a specific, optimal spin rate selected for both observatories that is within the specified allowable range		Inherited	IPLD - 186	EFW-119	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-11	**Instrument Accommodation of Observatory Selected Spin Rate Stability**	Each EFW Instrument	shall	be capable of collecting required science measurements at an observatory spin rate that is maintained to within +/- 0.25 rpm of the in-flight selected value, except during maneuvers.		Inherited	IPLD - 188	EFW-119	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-203	**Instrument Accommodation of Observatory Commissioning Spin Rate Range**	Each EFW Instrument	shall	be capable of accommodating an observatory spin rate during commissioning period activities within a range between 3 RPM and 15 RPM.		Inherited	IPLD - 150	EFW-119, RBSP_EFW_SPB_001	A,T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-12	**Instrument Accommodation of Unattended Mission Operations**	Each EFW Instrument	shall	be designed to accommodate periods of unattended mission operations (unstaffed MOC) during the operational phase of the mission of up to 5 days.		Inherited	IPLD - 178	RBSP_EFW_TE_001	T	FSW CPT, Mission Simulations	RBSP_EFW_FSW_024, Mission Simulations	RBSP_EFW_FSW_020C, Mission Simulations Report	Yes
EFW-13	**Instrument On-Board Burst Notification Generation**	Each EFW Instrument	shall	be capable of generating, and sending to the host spacecraft, a burst flag that indicates each respective instrument's determination of the general activity level of the external environment.		inherited	IPLD - 204	EFW-130,EFW-93	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-204	**Instrument On-Board Burst Notification Reception**	Each EFW Instrument	shall	be capable of receiving and responding to a message that represents a concatenation of the burst flags of other instruments on the same spacecraft		inherited	IPLD - 532	EFW-130	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes

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EFW-15	**Instrument Responsibility for On-Board Data Compression**	Each EFW Instrument	shall	be responsible for any and all on-board compression of their own data.		inherited	IPLD - 166	EFW-84	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	RBSP_EFW_FSW_020C, Instrument CPT Report	Yes
EFW-18	**Timeliness of Instrument Survey Data to Spacecraft**	Each EFW Instrument	shall	provide continuous mode survey science measurement data to the spacecraft within 24 hours of the time when the measurement was taken.		inherited	IPLD - 203	EFW-82	T	FSW CPT, Mission Simulations	RBSP_EFW_FSW_024, Mission Simulations	RBSP_EFW_FSW_020C, Mission Simulations Report	Yes
EFW-205	**Instrument Provision of Telemetry Supporting Fault Diagnosis**	Each EFW Instrument	shall	be designed to provide telemetry, within their own telemetry stream, sufficient to enable fault diagnosis by the appropriate SOC.		inherited	IPLD - 223	EFW-113	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-21	**EFW Instrument Complement**	Each EFW Instrument	shall	consist of four orthogonally oriented, boom-mounted spin-plane boom-mounted sensors, an Electronics Box, and two axial boom mounted sensors with harness as defined in the Spacecraft to EFW ICD.		inherited	IPLD - 231	EFW-53, EFW-54, EFW-55 EFW-56, EFW-88, EFW-89, EFW-90	I	Inspections, Travelers	Travelers	Travelers	Yes
EFW-22	**Functionally Identical EFW Instrument Suites**	Each EFW Instrument	shall	be functionally identical.		inherited	IPLD - 230	EFW-23	T	Calibrations, CPT	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan, RBSP_EFW_INT_012	Science Calibration Report, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report, Instrument CPT Report	Yes
EFW-23	**EFW - Spacecraft ICD Compliance**	Each EFW Instrument	shall	comply with the EFW-to-Spacecraft interface control documents (ICDs).		inherited	IPLD - 232, IPLD - 260, IPLD - 201, IPLD - 206, IPLD - 264, IPLD - 567, IPLD - 568, IPLD - 578, EFW-22	EFW-63, EFE-64, EFW-65, EFW-66, EFW-67, EFW-68, EFW-69, EFW75, EFW-76, EFW-77, EFW-78, EFW-79, EFW-80, EFW-81, EFW-82, EFW-83, EFW-85, EFW-86, EFW-87, EFW-88, EFW-89, EFW-90, EFW-91, EFW-92, EFW-96, EFW-96,EFW-103, EFW-104, EFW-105, EFW-106, EFW-107, EFW-108, EFW-111, EFW-112, EFW-116, EFW-135	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	RBSP_EFW_FSW_020C, Instrument CPT Report	Yes
EFW-24	**EFW Instrument Availability**	Each EFW Instrument	shall	be designed to be available for the collection of its required measurements at least 99% of the time during the operational phase of the mission		inherited	IPLD - 283	EFW-97, EFW-118	A, T	Analysis of probability and duration of events that cause data loss; Long duration functional tests	Mission Simulations	Mission Simulations Report	Yes
EFW-27	**EFW Maximum Daily Data Delivery Volume to Spacecraft**	Each EFW Instrument	shall	deliver no more than 1.0368 Gbits per day to its respective spacecraft during the science operations phase of the RBSP mission		inherited	IPLD - 287	EFW-82	T	FSW CPT, Mission Simulations	RBSP_EFW_FSW_024, Mission Simulations	RBSP_EFW_FSW_020C, Mission Simulations Report	Yes
EFW-29	**Instrument On-Orbit Parameter Load or Software Change Capability**	Each EFW Instrument	shall	be capable of modifying operational flight software and/or change calibration coefficients or tables in response to ground commands		inherited	IPLD - 229, EFW-200	EFW-109, EFW-114	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-32	**EFW Burst Data Delivery**	Each EFW Instrument	shall	be designed to telemeter a daily average of 32 MSamples of burst and interferometric wave data..	This data volume will support 3 hours of burst data containing three components each of electric and magnetic fields and a measurement of density at a rate of 300 samples/s. It simultaneously supports 86 seconds of interferometric timing data at a rate of 16,000 samples/s. On orbit burst rates and durations will be programmable	inherited	IPLD - 507	EFW-130, EFW-93	T	FSW CPT, Mission Simulations	RBSP_EFW_FSW_024, Mission Simulations	RBSP_EFW_FSW_020C, Mission Simulations Report	Yes
EFW-206	**EFW Timeliness of Burst Data Delivery to Spacecraft**	Each EFW Instrument	shall	provide selected science measurement data collected in burst mode to the spacecraft within 42 days of the time when the measurement was taken.	The requirement does not apply to EFW data collected in survey mode	inherited	IPLD - 297	EFW-118, EFW-93	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-33	**EFW Allocated Instrument Timing Knowledge Uncertainty**	Each EFW Instrument	shall	limit its internal instrument timing uncertainty to +/- 1 msec (3-sigma).	This is the maximum allowable error than can be introduced by the instrument itself in determining the time of an observation. NOTE: The value of ± 1 msec is required to satisfy the absolute time knowledge accuracy requirement per observatory; however, EFW internal timing accuracy is also needed to achieve the ≤ 3 degree observatory post-processed attitude knowledge requirement, but does not need to be as tight for attitude knowledge (5 ms, equivalent to 0.15 degrees).	inherited	IPLD - 212	EFW-110	T	Timing and Phasing test (Cal)	Instrument Timing and Phasing Test	Instrument Timing and Phasing Test Report	Yes

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EFW-35	**EFW On-Board Reception of EMFISIS Waves 3D Analog Search Coil Signals**	Each EFW Instrument	shall	be capable of receiving 3D buffered analog search coil signals from the EMFISIS Waves instrument aboard its respective observatory, as follows: -- frequency range: 10 Hz to 300 Hz; -- noise floor: < 1 x10-6 (nT)2/Hz at 100 Hz; -- dynamic range: 90 dB	Requirements (bandwidth, noise floor, and dynamic range) revised to be consistent with RBSP EFW to EMFISIS ICD (rev dash), APL document number 7417-9089	inherited	IPLD - 243	EFW-55,EFW-56,EFW-121	T	Cal	RBSP EFW-DFB Test Plan	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-207	**EFW On-Board Reception of EMFISIS DC-Coupled 3-Axis MAG Data**	Each EFW Instrument	shall	Each EFW instrument shall be capable, in the event of a failure of the EMFISIS MEB CDPU board, of digitizing each of the three DC-coupled, 3-axis analog signals received from the EMFISIS MAG instrument aboard its respective observatory, as follows: -- at a sampling rate of 64 samples per second; -- with an accuracy of 1.0% (goal of 0.1%) of the value of the total of the sensor voltage range; -- with the DC offset of the conversion less than 0.1% of	Requirements (bandwidth, noise floor, and dynamic range) revised to be consistent with RBSP EFW to EMFISIS ICD (rev C).	inherited	IPLD - 244	EFW-55,EFW-56,EFW-121	T	Cal	RBSP EFW-DFB Test Plan	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-215	**EFW Contingency Digitization of EMFISIS DC-Coupled 3-Axis MAG Signals**	Each EFW Instrument	shall	be capable, in the event of a failure of the EMFISIS MEB CDPU board, of digitizing each of the three DC-coupled, 3-axis analog signals received from the EMFISIS MAG instrument aboard its respective observatory, as follows: -- at a sampling rate of 64 samples per second; -- with an accuracy of 1.0% (goal of 0.1%) of the value of the total of the sensor voltage range; -- with the DC offset of the conversion less than 0.1% of the total maximum possible range of the signal;	Refer also to the RBSP EFW to EMFISIS ICD.	inherited	IPLD - 585	EFW-55, RBSP_EFW_DFB_001	T	Cal	RBSP EFW-DFB Test Plan & RBSP_EFW_FSW_024, RBSP_EFW_INT_012	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report, RBSP_EFW_FSW_020C, Instrument CPT Report	Yes
EFW-216	**Contingency EMFISIS MAG Data Digitized Data Packets**	Each EFW Instrument	shall	Each EFW instrument shall be capable of generating and providing to the spacecraft digitized 3-axis flux gate magnetometer data packets, as follows: -- when manually commanded to do so; -- as derived from analog signals received from EMFISIS MAG and digitized by EFW (see IPLD-585); -- in CCSDS-compliant packets; -- with each packet containing data for 512 samples (8 seconds of data at 64 samples per second) of the measurement, 16 bits per axis, 3 axis measurements per sample; -- encoded with a unique identifier (APID).	This capability is intended for use in the event of a failure of the EMFISIS MEB CDPU board, and would not be exercised under nominal operational conditions. Refer also to the RBSP EFW to EMFISIS ICD.	inherited	IPLD - 586	EFW-217	T	Cal	RBSP EFW-DFB Test Plan & RBSP_EFW_FSW_024, RBSP_EFW_INT_012	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report, RBSP_EFW_FSW_020C, Instrument CPT Report	Yes
EFW-36	**EFW On-Board Delivery of Signals and to EMFISIS - Spin Plane Sensor Pairs**	Each EFW Instrument	shall	be capable of providing buffered, analog probe voltage difference signals for two orthogonal pairs of spin plane electric field sensors directly to the EMFISIS instrument suite aboard its respective observatory, specified in terms of two frequency ranges, as follows: Frequency Range 1: -- frequency range: from 10 Hz to 12 kHz; -- sensitivity: 3.10-14 (V/m)2/Hz at 1 kHz; -- bandwidth: 175 Hz; -- dynamic range: 100 dB. Frequency Range 2: -- frequency range: from 10 kHz to 400 kHz; -- sensitivity: 3.10-17 (V/m)2/Hz at 100 kHz; -- bandwidth: 7 kHz; -- dynamic range: 100 dB; -- maximum signal amplitude: 30 mV/m at 1 kHz.	Requirements (bandwidth, noise floor, and dynamic range) revised to be consistent with RBSP EFW to EMFISIS ICD (rev C).	inherited	IPLD - 245	EFW-53,EFW-54,EFW-55,EFW-56,EFW-131, EFW-102	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028	Yes
EFW-208	**EFW On-Board Delivery of Signals to EMFISIS - Single Pair Axial**	Each EFW Instrument	shall	be capable of providing a buffered, analog spin axis electric field measurement directly to the EMFISIS instrument suite aboard its respective observatory, specified in terms of two frequency ranges, as follows: Frequency Range 1: -- frequency range: from 10 Hz to 12 kHz; -- bandwidth: 175 Hz; -- dynamic range: 80 dB; -- sensitivity: 3.10-12 (V/m)2/Hz at 100 Hz. Frequency Range 2: -- frequency range: from 10 kHz to 400 kHz; -- bandwidth: 7 kHz; -- dynamic range: 80 dB; -- sensitivity: 3.10-15 (V/m)2/Hz at 100 kHz; -- maximum signal amplitude: 30 mV/m at 1 kHz	Requirements (bandwidth, noise floor, and dynamic range) revised to be consistent with RBSP EFW to EMFISIS ICD (rev C). Note: The aft axial boom will sometimes be in spacecraft shadow and cannot be used in constructing a differential signal at those times.	inherited	IPLD - 246	EFW-214, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028	Yes

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EFW-213	**EFW Space Weather Data Products**	Each EFW Instrument	shall	be capable of generating and providing to the spacecraft the following measurement data, for inclusion in near-real-time space weather broadcasts: 2D Spin Plane Vector Electric Field: -- at a cadence of 1 vector per spin; -- 2 components in de-spun coordinates; Spacecraft Potential (Plasma Density): -- spacecraft potential; -- at a cadence of once per spin	Instruments will choose space weather data from measurements based on information normally available to the instrument	inherited	IPLD-574, IPLD-591	EFW-130, EFW-124	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024 & RBSP_EFW_INT_012	FSW CPT, Instrument CPT Report	Yes
EFW-37	**EFW Space Weather Data Product Identification**	Each EFW Instrument	shall	Each EFW instrument shall deliver space weather data to the spacecraft in packets that are separate from other EFW data and are uniquely identifiable as space weather data packets.		inherited	IPLD - 308	EFW-53,EFW-55,EFW-56	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024 & RBSP_EFW_INT_012	FSW CPT, Instrument CPT Report	Yes
EFW-209	**EFW Spin Axis Measurement Sensitivity Validty**	Each EFW Instrument	shall	meet Spin Axis measurement sensitivity requirements outside time periods defined as follows: the interval where the aft axial boom is shadowed by the spacecraft or solar panels, and 25 seconds after the end of such periods.		inherited	IPLD - 552, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	RBSP_EFW_DFB_001	A, T	Cal	RBSP EFW-DFB Test Plan	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-43	**Measure 3D Low-Frequency AC Magnetic Field Cross-Spectra**	Each EFW Instrument	shall	measure 3-D low frequency AC magnetic field cross-spectra, as follows: -- using the EMFISIS search coil signal; -- frequency range: 10 Hz to 300 Hz]; -- magnitude range: 90 dB; -- cadence: every 1 spin; -- sensitivity: 1 x 10-6 nT2/Hz@ 100 Hz	consider a 3-D AC magnetic field (survey) measurement to be unobtainable or otherwise invalid under the following operational conditions: -- When EMFISIS signals are not valid (reference IPLD 490, 492).	inherited	IPLD - 68, IPLD - 491, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53, EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP EFW-DFB Test Plan	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-44	**Measure AC Magnetic Field (Burst)**	Each EFW Instrument	shall	measure burst AC magnetic field, as follows: -- using EMFISIS magnetic search coil data; -- frequency range: 10 Hz-250 Hz; -- magnitude range: 90 dB; -- cadence: 512 samples/sec; -- sensitivity: 1 x10-6 (nT)2/Hz at 100 Hz.	consider a 3-D AC magnetic field (burst) measurement to be unobtainable or otherwise invalid under the following operational conditions: -- When EMFISIS signals are not valid (reference IPLD 490, 492).	inherited	IPLD - 71, IPLD - 493, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP EFW-DFB Test Plan	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-45	**Measure Interferometric Timing (Burst)**	Each EFW Instrument	shall	perform interferometric timing measurements at high cadence using independent measurements from each of the paired probes, as follows: -- for waves of .1 mV/m to 300 mV/m, velocity range of 0 - 500 km/s in spin plane, and wave spatial scales of 0.1 -30 km when inter-probe wave coherence >0.5 -- cadence: 16 k samples/sec (214 samples/s); -- sensitivity: 0.05 mV/m	consider an interferometric timing measurement to be unobtainable or otherwise invalid under the following operational conditions: -- All probes are not illuminated	inherited	IPLD - 61, IPLD - 505, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-46	**Measure Spin Plane DC Electric Field (Survey)**	Each EFW Instrument	shall	measure an electric field component perpendicular to the observatory spin axis (survey), as follows: -- frequency range: DC to 15 Hz; -- magnitude range: 0 to 500 mV/m, at geocentric distances greater than 2.5 Re; -- cadence: 32 vectors/second; -- sensitivity: 0.3 mV/m or 10% for R > 3.5 Re, 3.0 mV/m for 2.5 Re < R < 3.5 Re 10 mV/m for 1.5 Re < R < 2.5 Re.	consider a spin plane DC electric field (survey) measurement to be unobtainable when: 1) the spacecraft is in Earth shadow; 2) the spin plane boom pointing requirements are not met; 3) magnetic field data is not within required accuracy; 4) spacecraft attitude information is not within required specifications; 5) spacecraft velocity measurements are not within specification; 6) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt).	inherited	IPLD - 38, IPLD - 494, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-47	**EFW Spin Plane Cold Plasma Density Measurements**	Each EFW Instrument	shall	determine cold plasma density by measuring the observatory (spacecraft) potential· as follows: -- magnitude range: 0.1 - 50 cm-3, for electron temperatures less than 30 eV; -- cadence: 1 sample per second; -- sensitivity 50%.	consider a cold plasma density measurement to be unobtainable when: 1) the electron temperature is above 30 eV; 2) the spacecraft is in Earth shadow; 3) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt).	inherited	IPLD - 55, IPLD - 503, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	A, T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes

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EFW-48	**Measure Low-Frequency AC Electric Field Cross Spectra**	Each EFW Instrument	shall	measure low frequency AC electric field cross-spectra, as follows: -- frequency range: 10 Hz to 300 Hz; -- magnitude range: 80 dB; -- cadence: 6 seconds; -- sensitivity: 1x10-12 (V/m)2/Hz at 30 Hz, 1x10-14 (V/m)2/Hz at 300 Hz.	consider a 3-D low-frequency AC electric field (survey) measurement to be unobtainable or otherwise invalid under the following operational conditions: -- When EMFISIS signals are not valid (reference IPLD 490, 492).:	inherited	IPLD - 66, IPLD - 499, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-49	**Measure Spin Plane DC Electric Field (Burst)**	Each EFW Instrument	shall	measure an electric field component perpendicular to the observatory spin axis (burst), as follows: -- frequency range: DC to 250 Hz; -- magnitude range: 0.3 - 500 mV/m; -- cadence: 512 samples per second; -- sensitivity: 10-12 (V/m)2/Hz at 30 Hz 10-14 (V/m)2/Hz at 300 Hz.	consider a spin plane DC electric field (burst) measurement to be unobtainable when: 1) the spacecraft is in Earth shadow; 2) the spin plane boom pointing requirements are not met; 3) spacecraft attitude information is not within required specifications; 4) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt).	inherited	IPLD - 42, IPLD - 495, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-50	**Measure Density Perturbation (Burst)**	Each EFW Instrument	shall	measure density perturbations (burst), as follows: -- frequency range: DC to 250 Hz; -- magnitude range: 0.1 - 50 cm-3, (<30 eV electrons); -- cadence: 512 samples per second; -- sensitivity (dn/n): ~ 10%.	consider a cold plasma density perturbation measurement to be unobtainable when: 1) the electron temperature is above 30 eV; 2) the spacecraft is in Earth shadow; 3) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt); 4) density is above 300 cm-3.	inherited	IPLD - 59, IPLD - 504, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-53,EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-51	**Measure Spin Axis DC Electric Field (Survey)**	Each EFW Instrument	shall	measure axial electric field components (survey), as follows: -- frequency range: DC to 15Hz; -- magnitude range: 2 mV/m - 500 mV/m; -- cadence: 32 vectors/second; -- sensitivity: 4 mV/m or 20% for R > 3.5 Re, 6 mV/m or 20% for 3.5 Re > R > 2.5 Re, 12 mV/m or 20% for 1.5 Re < R < 2.5 Re.	consider a spin axis DC electric field (survey) measurement to be unobtainable when: 1) the spacecraft is in Earth shadow; 2) the spin axis boom pointing requirements are not met; 3) magnetic field data is not within required accuracy; 4) spacecraft attitude information is not within required specifications; 5) spacecraft velocity measurements are not within specification; 6) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt); 7) the aft spin axis boom is in spacecraft shadow.	inherited	IPLD - 44, IPLD - 496, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes

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EFW-52	**Measure Spin Axis DC Electric Field (Burst)**	Each EFW Instrument	shall	measure axial electric field components (burst), as follows: -- frequency range: DC to 256 Hz; -- magnitude range: 0.4 - 500 mV/m; -- cadence: 512 samples per second; -- sensitivity: 1 mV/m or 10% @ 50 Hz.	consider a spin axis DC electric field (burst) measurement to be unobtainable when: 1) the spacecraft is in Earth shadow; 2) the spin axis boom pointing requirements are not met; 3) spacecraft attitude information is not within required specifications; 4) the electrostatic cleanliness specification is not capable of controlling differential charging of spacecraft surface (i.e., differential charging across spacecraft surface > 1 volt); 5) the aft spin axis boom is in spacecraft shadow.	inherited	IPLD - 47, IPLD - 497, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	EFW-54,EFW-55,EFW-56, RBSP_EFW_DFB_001	T	Cal	RBSP_EFW_INT_007, RBSP_EFW_009, RBSP_EFW_011, RBSP EFW-DFB Test Plan	RBSP_EFW_TR_026, RBSP_TR_027, RBSP_TR_028, LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report	Yes
EFW-218	**EFW Axial Boom Structural Mode Frequencies**	Each EFW instrument	shall	be developed such that the structural mode frequencies for the EFW axial booms is at least 1.5 times the maximum planned operational spin rate of 6 RPM or above 0.15 Hz.		Derived	IPLD-588	EFW-54	A	Mass Properties Analysis	RBSP_EFW_SYS_003	RBSP_EFW_SYS_003W	Yes
EFW-219	**EFW Spin Plane Boom Wire Damping Capacity**	Each EFW instrument	shall	be developed such that the damping capacity of the wire used for the EFW spin plane booms is at least 0.020 J (or J/rad2) where this capacity is measured as the change in energy per cycle divided by the squared amplitude of the deflection angle (in radians) of a pendulum made of the wire operating in a vacuum with tension along the wire equal to that experienced in flight at the nominal spin rate of 5 rpm.		Derived	IPLD-589	EFW-53	A	Damping Analysis	RBSP_GNC_RawDampingTestAnalysis.pdf	RBSP_GNC_RawDampingTestAnalysis.pdf	Yes
EFW-220	**EFW Axial Boom Total Static Internal Alignment Error**	Each EFW instrument	shall	be developed such that the total static internal alignment error of each EFW axial boom (deployed) is ≤ 1.0 degrees (3-sigma).		Derived	IPLD-590	EFW-54a	T	Deployment test	RBSP_EFW_AXB_008C	Completed Procedure RBSP_EFW_AXB_008C	Yes
				Required Components to Achieve Above									
EFW-53	**EFW Spin Plane E-Field Booms**	Each EFW SPB	shall	be capable of deploying 50 meters of wire with an E-Field sensor preamp at the end capable of measuring E-Fields to 400 kHz		derived	EFW-37, EFW-49, EFW-36, EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-50,EFW-219	EFW-56, EFW-92a, RBSP_EFW_SPB_001	T	Deployment tests, Preamp tests	RBSP-SPB-PRO-107, RBSP_EFW_PRE_SPB_008C	Completed Procedures of RBSP-SPB-PRO-107, RBSP_EFW_PRE_SPB_008C	Yes
EFW-54	**EFW Axial E-Field Booms**	Each EFW AXB	shall	be capable of deploying 7 meters with an E-Field sensor preamp at the end capable of measuring E-Fields to 400 kHz		derived	EFW-37, EFW-45, EFW-46, EFW-36, EFW-48,EFW-50, EFW-51, EFW-52,EFW-218	EFW-56, EFW-92a, RBSP_EFW_AXB_001	T	Deployment tests, Preamp tests	RBSP_EFW_AXB_014D, RBSP_EFW_AXB_008C, RBSP_EFW_PRE_AXB_007B	Completed Procedures of RBSP_EFW_AXB_014D, RBSP_EFW_AXB_008C, RBSP_EFW_PRE_AXB_007B	Yes
EFW-54a	**EFW Axial E-Field Booms**	Each EFW AXB	shall	Deploy the AXB sensors within +/- 1 degree of the AXB deployment system axis		derived	EFW-51, EFW-220	RBSP_EFW_AXB_001	T	Deployment test	RBSP_EFW_AXB_008C	Completed Procedure RBSP_EFW_AXB_008C	Yes
EFW-55	**EFW Instrument Data Processor Unit**	Each EFW IDPU	shall	house and provide EMC closeout, thermal control, and radiation protection to the following: boom electronics, a/d circuitry, E-Field buffers, computer and solid state recorder, power controller, and power converter.		derived	EFW-43, EFW-44, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52, EFW-215, EFW-207, EFW-36, EFW-101	EFW-56, EFW-57,EFW-58,EFW-59,EFW-60,EFW-61,EFW-62	I, A, T	EMC Test, Thermal vac test	Instrument EMC Test Procedure, IDPU TVAC Procedure	Instrument EMC Test Report, IDPU TVAC Procedure	Yes
EFW-56	**EFW Harnessing**	Each EFW Harness	shall	connect the SPB, AXB, IDPU, EMFISIS/MAG and EMFISIS/SCM units together as detailed in the ICDs		derived	EFW-53, EFW-54, EFW-55, EFW-37, EFW-42, EFW-207, EFW-36, EFW-45, EFW-46, EFW-47, EFW-48, EFW-49, EFW-50, EFW-51, EFW-52	RBSP_EFW_SYS_015	D	Harness Drawings, Instrument CPT	RBSP_EFW_SYS_015, RBSP_EFW_INT_012 Procedure	Instrument CPT Report	Yes
EFW-57	**EFW Boom Electronics**	Each EFW IDPU	shall	contain Boom Electronics Board (BEB) which will control four SPB sensors and 2 AXB sensors.		derived	EFW-55	RBSP_EFW_BEB_001	D,T	BEB Schematics, BEB Test, Instrument CPT	RBSP_EFW_BEB_002, BEB Test Procedure, RBSP_EFW_INT_012, Instrument Noise Test	RBSP_EFW_BEB_002, BEB Test Report, Instrument CPT Report, Instrument Noise Report	Yes
EFW-58	**EFW Analog/Digital Conversion**	Each EFW IDPU	shall	contain Digital Fields Board (DFB) which will digitize SPB, AXB, and EMFISIS signals and perform other analyses		derived	EFW-55	RBSP_EFW_DFB_001	D,T	DFB Schematics, DFB Test, Instrument CPT	RBSP EFW-DFB Test Plan, RBSP_EFW_INT_012	LASP RBSP EFW DFB FM2 Test Report, LASP RBSP EFW DFB FM1 Test Report, Instrument CPT Report	Yes
EFW-59	**EFW E-Field Buffering**	Each EFW IDPU	shall	contain circuitry to buffer differential E-Field signals to EMFISIS		derived	EFW-55	RBSP_EFW_BEB_001	D,T	BEB Schematics, BEB Test, Instrument CPT	RBSP_EFW_BEB_002, BEB Test Procedure, RBSP_EFW_INT_012, Instrument Noise Test	RBSP_EFW_BEB_002, BEB Test Report, Instrument CPT Report, Instrument Noise Report	Yes
EFW-60	**EFW Data Processing**	Each EFW IDPU	shall	contain a processor and solid-state recorder capable of recording and playing back E-Field and B-Field data		derived	EFW-55	EFW-118, RBSP_EFW_DCB_003	D,T	DCB Schematics, FSW CPT, Instrument CPT	RBSP_EFW_DCB_004, RBSP_EFW_FSW_024 Procedure, RBSP_EFW_INT_012 Procedure	RBSP_EFW_FSW_020C, Instrument CPT Report	Yes

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EFW-61	**EFW Power Control**	Each EFW IDPU	shall	contain circuitry to open SPB and AXB doors and deploy sensors		derived	EFW-55	RBSP_EFW_LVPS_001	D, T	LVPS Schematics, LVPS Test, Instrument CPT	RBSP_EFW_LVPS_002, LVPS Test Report, RBSP_EFW_INT_012 Procedure	LVPS Test Report, Instrument CPT Procedure	Yes
EFW-62	**EFW Low Voltage Conversion**	Each EFW IDPU	shall	contain circuitry to provide voltages to IDPU boards using the S/C-provided 28Volts		derived	EFW-55	RBSP_EFW_LVPS_001	D, T	LVPS Schematics, LVPS Test, Instrument CPT	RBSP_EFW_LVPS_002, LVPS Test Report, RBSP_EFW_INT_012 Procedure	LVPS Test Report, Instrument CPT Procedure	Yes
				3.2 Power allocations and related requirements									
EFW-63	**EFW Main Power Allocation**	Each EFW Instrument	shall	not exceed the total power of 11.16W from the EFW Main 28V Service		derived	EFW-23	EFW-98, RBSP_EFW_BEB_001, RBSP_EFW_DFB_001, RBSP_EFW_DCB_003, RBSP_EFW_LVPS_001	T	Instrment CPT	RBSP_EFW_INT_012 Procedure	Instrument CPT Report	Yes
EFW-64	**EFW Main Power In-Rush**	Each IDPU	shall	not exceed ICD values as follows: 10A for 100 usec; 5A for 100us to 1ms 2.5A after 1ms		derived	EFW-23	RBSP_EFW_LVPS_001	T	LVPS Functional Test, Instrument EMC Test	LVPS Test Procedure, Instrument EMC Procedure	LVPS Test Report, Instrument EMC Report	Yes
EFW-65	**EFW Main Power Max Voltage**	Each IDPU	shall	tolerate without damage a maximum input voltage of 40V indefinitely as defined in the ICD		derived	EFW-23	RBSP_EFW_LVPS_001	T	LVPS Functional Test	LVPS Test Procedure	LVPS Test Report	Yes
EFW-66	**EFW Main Power Turn Off**	Each IDPU	shall	tolerate without damage having power removed without notice as defined in the ICD		derived	EFW-23	RBSP_EFW_LVPS_001	T	LVPS Functional Test, Instrument EMC Test	LVPS Test Procedure, RBSP_EFW_INT_012 Procedure	LVPS Test Report, Instrument CPT Report	Yes
EFW-67	**EFW SPB Deployment Power**	Each EFW SPB	shall	not exceed 4.0 Amps from the EFW SPB Deployment Service		derived	EFW-23	EFW-70,EFW-71, EFW-98, EFW-99	T	Deployment Tests & SPB TVAC	SPB Deployment Test, RBSP-SPB-PRO-102	SPB Deployment Test, RBSP-SPB-PRO-102	Yes
EFW-68	**EFW AXB Deployment Power**	Each EFW AXB	shall	not exceed 4.0 Amps from the EFW AXB Deployment Service		derived	EFW-23	EFW-72,EFW-73,EFW-74, EFW-98, EFW-100	T	Deployment Tests, AXB Whip TVAC, AXB Stacer TVAC	RBSP_EFW_AXB_014D, RBSP_EFW_AXB_026, RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022	RBSP_EFW_AXB_014D, RBSP_EFW_AXB_026, RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022	Yes
EFW-69	**EFW Survival Heaters**	Each EFW Suite	shall	accommodate survival heaters up to 1/2 nominal power at 22V bus voltage, or approximately 113 Ohms if necessary.		derived	EFW-23	*not used*	-	*not used*	N/A	N/A	N/A
				3.3 Performance budget sub-allocations with respect to system budgets									
EFW-70	**EFW SPB Door Power**	Each EFW SPB	shall	not exceed 2.0 Amps at 28V		budgeted	EFW-67	RBSP_EFW_SPB_001	T	SPB and Instrument Deployment Tests & SPB TVAC	RBSP-SPB-PRO-107, RBSP-SPB-PRO-102, RBSP_EFW_INT_006C	Completed procedures RBSP-SPB-PRO-107, RBSP-SPB-PRO-102, RBSP_EFW_INT_006C	Yes
EFW-71	**EFW SPB Motor Power**	Each EFW SPB	shall	not exceed 0.2 Amps at 28V (1.5A startup)		budgeted	EFW-67	RBSP_EFW_SPB_001	T	SPB and Instrument Deployment Tests & SPB TVAC	RBSP-SPB-PRO-107, RBSP-SPB-PRO-102, RBSP_EFW_INT_006C	Completed procedures RBSP-SPB-PRO-107, RBSP-SPB-PRO-102, RBSP_EFW_INT_006C, Motor Burn in Test Results	Yes
EFW-72	**EFW AXB Whip Release Power**	Each EFW AXB	shall	not exceed 2.0 Amps at 28V		budgeted	EFW-68	RBSP_EFW_AXB_001	T	AXB and Instrument Deployment Tests & AXB Whip TVAC	RBSP_EFW_AXB_014D, RBSP_EFW_AXB_026, RBSP_EFW_INT_008C	Completed Procedures of RBSP_EFW_AXB_014D, RBSP_EFW_AXB_026, RBSP_EFW_INT_008C	Yes
EFW-73	**EFW AXB Stacer Release Power**	Each EFW AXB	shall	not exceed 2.0 Amps at 28V		budgeted	EFW-68	RBSP_EFW_AXB_001	T	AXB and Instrument Deployment Tests & AXB Stacer TVAC	RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022, RBSP_EFW_INT_010	Completed Procedures of RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022, RBSP_EFW_INT_010	Yes
EFW-74	**EFW AXB Motor Power**	Each EFW AXB	shall	not exceed 0.2 Amps at 28V (1.5A startup)		budgeted	EFW-68	RBSP_EFW_AXB_001	T	AXB and Instrument Deployment Tests & AXB Stacer TVAC	RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022	RBSP_EFW_AXB_008C, RBSP_EFW_AXB_022, Motor Burn in Test Results	Yes
				3.4 Operational requirements									
EFW-75	**EFW IDPU Operational Temp Range**	The EFW IDPU	shall	perform as designed from -25 to +55C	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_BPL_001	T	Instrument Thermal Vac	Instrument Thermal Vacuum Test Procedure	Instrument Thermal Vacuum Test Report	Yes
EFW-76	**EFW SPB Operational Temp Range**	The EFW SPB	shall	perform as designed from -25 to +55C	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_SPB_001	T	SPB Thermal Vac	RBSP-SPB-PRO-102	RBSP-SPB-PRO-102	Yes
EFW-77	**EFW AXB Operational Temp Range**	The EFW AXB	shall	perform as designed from -25 to +55C for the Stacer, -25 to +65C for the Whip	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_AXB_001	T	AXB Thermal Vac	RBSP_EFW_AXB_022, RBSP_EFW_AXB_026	RBSP_EFW_AXB_022, RBSP_EFW_AXB_026	Yes
EFW-78	**EFW IDPU Survival Temp Range**	The EFW IDPU	shall	survive without damage from -30 to +60C	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_BPL_001	T	Instrument Thermal Vac	Instrument Thermal Vacuum Test Procedure	Instrument Thermal Vacuum Test Report	Yes
EFW-79	**EFW SPB Survival Temp Range**	The EFW SPB	shall	survive without damage from -30 to +60C	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_SPB_001	T	SPB Thermal Vac	RBSP-SPB-PRO-102	RBSP-SPB-PRO-102	Yes
EFW-80	**EFW AXB Survival Temp Range**	The EFW AXB	shall	survive without damage from -30 to +60C for Stacer, -30 to +70C for the Whip	Assumes conductively mounted to spacecraft	derived	EFW-23	RBSP_EFW_AXB_001	T	AXB Thermal Vac	RBSP_EFW_AXB_022, RBSP_EFW_AXB_026	RBSP_EFW_AXB_022, RBSP_EFW_AXB_026	Yes
				3.5 Command and telemetry requirements									
EFW-81	**EFW Command**	The EFW IDPU	shall	accept commands via serial interface		derived	EFW-23,EFW-29	EFW-111	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes
EFW-82	**EFW Telemetry Rate**	The EFW IDPU	shall	generate a continuous, serial telemetry stream at a rate not to exceed 12,000 bps.		derived	EFW-18, EFW-23, EFW-27	EFW-112	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes
EFW-83	**EFW Telemetry Peak**	The EFW IDPU	shall	limit the instantaneous data rate to the spacecraft to ≤80 kbps		derived	EFW-23	EFW-112	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes

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EFW-84	**EFW Telemetry Compression**	The EFW IDPU	shall	perform data compression		derived	EFW-15	EFW-129	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes
EFW-85	**EFW use of MET**	The EFW IDPU	shall	use Mission Elapsed Time (MET) as the reference time for time stamps produced for science, space weather, and instrument housekeeping data.		derived	EFW-23	EFW-110	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes
EFW-86	**EFW MET Acceptance**	The EFW IDPU	shall	accept the distribution of MET from its respective spacecraft at a frequency of 1 Hz.		derived	EFW-23	EFW-111	T	FSW CPT, Instrument CPT	RBSP_EFW_FSW_024, RBSP_EFW_INT_012	FSW CPT Test Report, Instrument CPT Test Report	Yes
				3.6 Interfaces to the spacecraft bus									
EFW-87	**EFW Serial Interface**	The EFW IDPU	shall	accommodate a standard point-to-point serial interface for data exchange with the spacecraft.		derived	EFW-23	RBSP_EFW_DFB_001, RBSP_EFW_FSW_002	D, T	DCB Schematics, Instrument CPT	RBSP_EFW_DCB_009, RBSP_EFW_INT_012	Instrument CPT Report	Yes
EFW-88	**EFW IDPU ICD Compliance**	The EFW IDPU	shall	comply with the requirements and constraints imposed by all relevant instrument-to-spacecraft interface control documents (ICDs).		derived	EFW-23	RBSP_EFW_BPL_001	I,T	IDPU ICD, Instrument CPT	RBSP-IDP-MEC-500, RBSP_EFW_INT_012, ICD Verification Matrix	Instrument CPT Report, ICD Verification Matrix	Yes
EFW-89	**EFW SPB ICD Compliance**	The EFW SPB	shall	comply with the requirements and constraints imposed by all relevant instrument-to-spacecraft interface control documents (ICDs).		derived	EFW-23	RBSP_EFW_SPB_001	I,T	SPB ICD, SPB CPT	RBSP-SPB-ICD-001F, RBSP-SPB-PRO-101, ICD Verification Matrix	RBSP-SPB-ICD-001F, RBSP-SPB-PRO-101, ICD Verification Matrix	Yes
EFW-90	**EFW AXB ICD Compliance**	The EFW AXB	shall	comply with the requirements and constraints imposed by all relevant instrument-to-spacecraft interface control documents (ICDs).		derived	EFW-23	RBSP_EFW_AXB_001	I,T	AXB ICD, AXB CPT	RBSP-AXB-ICD-001E, RBSP_EFW_AXB_021, ICD Verification Matrix	RBSP-AXB-ICD-001E, RBSP_EFW_AXB_021, ICD Verification Matrix	Yes
				3.7 Umbilical interfaces									
				not applicable									
				3.8 System test Interfaces									
EFW-91	**SPB Signal Test Input**	Each EFW SPB	shall	provide a connector for test input to the sensor accessible during all integration phases.		derived	EFW-23	RBSP_EFW_SPB_001	D	SPB ICD	RBSP-SPB-ICD-001F	RBSP-SPB-ICD-001F	Yes
EFW-92	**AXB Signal Test Input**	Each EFW AXB	shall	provide a connector for test input to the sensor accessible when the top and bottom of the spacecraft are accessible.		derived	EFW-23, EFW-53, EFW-54	RBSP_EFW_AXB_001	D	AXB ICD	RBSP-AXB-ICD-001E	RBSP-AXB-ICD-001E	Yes
				3.9 Instrument modes									
EFW-92a	**EFW Engineering Mode**	The EFW IDPU	shall	provide an Engineering Mode for deployments		derived	EFW-53,EFW-54	RBSP_EFW_FSW_002	T	Instrument CPT	RBSP_EFW_INT_012 Procedure	Instrument CPT Report	Yes
EFW-93	**EFW Normal Mode**	The EFW IDPU	shall	provide a Normal Mode for science data collection		derived	EFW-13, EFW-32, EFW-206, EFW-43, EFW-44, EFW-48, EFW-49, EFW-51, EFW-131	RBSP_EFW_FSW_002	T	Instrument CPT	RBSP_EFW_INT_012 Procedure	Instrument CPT Report	Yes
				3.10 Fault detection and correction considerations/requirements									
EFW-96	**EFW Illegal Commands**	The EFW IDPU	shall	validate commands prior to execution.		derived	EFW-23	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-97	**EFW Data Integrity**	The EFW IDPU	shall	detect and correct data errors in its Solid State Recorder.		derived	EFW-24	RBSP_EFW_FSW_002	T	RBSP_EFW_DCB_001	DCB FPGA Design Analysis	DCB FPGA Design Analysis	Yes
EFW-98	**EFW Illegal Power States**	The EFW IDPU	shall	not be damaged by the application of boom power while the Main power is Off.		derived	EFW-63,EFW-67,EFW-68	RBSP_EFW_LVPS_001	T	LVPS Test	RBSP_EFW_LVPS_004D	Completed copy of RBSP_EFW_LVPS_004D in LVPS Traveler	Yes
EFW-99	**EFW SPB Deployment Enable**	The EFW IDPU	shall	not deploy SPB booms or fire SPB actuators without the SPB and Main power ON.		derived	EFW-67	EFW-122, EFW=117, RBSP_EFW_LVPS_001	T	LVPS Test Procedure	RBSP_EFW_LVPS_004D	Completed copy of RBSP_EFW_LVPS_004D in LVPS Traveler	Yes
EFW-100	**EFW AXB Deployment Enable**	The EFW IDPU	shall	not deploy AXB booms or fire AXB actuators without the AXB and Main power ON.		derived	EFW-68	EFW-122, EFW=117, RBSP_EFW_LVPS_001	T	LVPS Test Procedure	RBSP_EFW_LVPS_004D	Completed copy of RBSP_EFW_LVPS_004D in LVPS Traveler	Yes
				3.11 Redundancy description									
EFW-101	**EFW Boom Pair Redundancy**	The EFW IDPU	shall	have separate supplies for each preamp boom axis		derived	EFW-55	RBSP_EFW_LVPS_001	T	LVPS Test	RBSP_EFW_LVPS_004D	Completed copy of RBSP_EFW_LVPS_004D in LVPS Traveler	Yes
EFW-102	**EFW Safing by subsystem**	The EFW IDPU	shall	continue to provide EMFISIS with E-Field signals on failure of DCB or DFB		derived	EFW-36	RBSP_EFW_LVPS_001	T	LVPS Test	RBSP_EFW_LVPS_004D	Completed copy of RBSP_EFW_LVPS_004D in LVPS Traveler	Yes
				3.12 Mass allocation									
EFW-103	**EFW Total Mass**	Each EFW Instrument	shall	The EFW shall not exceed the total allocated mass budget of 31.62kg (or as allocated in RBSP System Mass Budget).		derived	EFW-23	RBSP_EFW_TE_001	T	Mass Properties	Mass Properties	Unit Travelers	Yes
EFW-104	**EFW IDPU Mass**	The EFW IDPU	shall	not exceed 9.73kg		derived	EFW-23	RBSP_EFW_TE_001	T	Mass Properties	Mass Properties	IDPU Travelers	Yes
EFW-105	**EFW SPB Mass**	The EFW SPB	shall	not exceed 2.43 kg		derived	EFW-23	RBSP_EFW_SPB_001	T	Mass Properties	Mass Properties	SPB Travelers	Yes
EFW-106	**EFW AXB Mass**	The EFW AXB	shall	not exceed 3.40 kg		derived	EFW-23	RBSP_EFW_AXB_001	T	Mass Properties	Mass Properties	AXB Travelers	Yes
EFW-107	**EFW AXB Tube Mass**	The EFW AXB Tube	shall	not exceed 1.29 kg		derived	EFW-23	RBSP_EFW_AXB_001	T	Mass Properties	Mass Properties	AXB Travelers	Yes
EFW-108	**EFW Harness Mass**	The EFW Harness	shall	not exceed 4.06kg		derived	EFW-23	RBSP_EFW_SYS_200	T	Mass Properties	Mass Properties	Harness Travelers	Yes
				3.13 Summary of software requirements and Interfaces									
EFW-109	**EFW FSW Program Execution**	The EFW FSW	shall	provide the capability for uploading programs and running them in the instrument;	EXEC	derived	EFW-29	EFW-115, RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-110	**EFW FSW Timing**	The EFW FSW	shall	provide a timing module which will perform scheduled activities under interrupt processing	BKG	derived	EFW-33, EFW-85	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-111	**EFW FSW Commands**	The EFW FSW	shall	provide a command module which injests command strings and executes them	CMD	derived	EFW-81, EFW-86	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-112	**EFW FSW Telemetry**	The EFW FSW	shall	provide a telemetry module which provides a continuous telemetry stream to the spacecraft	TM	derived	EFW-82	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes

ID	Req. Title	Subject	Priority	Requirement Body or Section Heading	Description / Clarification	Source Type	Rationale	*Impacts / Effects*	*Verification Method*	*Description of where Verification Met*	*Document / Procedure No.*	*Test Report showing Verification*	*Requirement Fully Met*
EFW-113	**EFW FSW Housekeeping**	The EFW FSW	shall	provide a housekeeping sampling routine which measures analog voltages, temperatures, etc and provides engineering packets to telemetry.	HSK	derived	EFW-205	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-114	**EFW FSW Loader**	The EFW FSW	shall	provide a loader module which writes RAM or EEPROM and can dump out the contents of memory.	LD	derived	EFW-29	EFW-123, RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-115	**EFW FSW Utilities**	The EFW FSW	shall	provide math utilities as required by other modules	UTIL	derived	EFW-109-EFW-130	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-116	**EFW FSW Input/Output**	The EFW FSW	shall	provide a structured input/output module which communicates with IDPU hardware according to specification.	IO	derived	EFW-23, RBSP_EFW_DCB_001, RBSP_EFW_DCB_003	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-117	**EFW FSW Power Control**	The EFW FSW	shall	provide a power module which controls the EFW deployment switches	PWR	derived	EFW-99, EFW-100	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-118	**EFW FSW Recorder Control**	The EFW FSW	shall	provide a Solid State Recorder module store and retreive all science data	SSR	derived	EFW-24, EFW-206, EFW-60	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-119	**EFW FSW Attitude**	The EFW FSW	shall	provide a module to determine the roll phase of the spacecraft in order to collect EFW and MAG Spin Fit samples at the right phase angle.	ACS	derived	EFW-11,EFW-10,EFW-9, EFW-203	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-120	**EFW FSW E-Field Sampling**	The EFW FSW	shall	provide a module to operate the BEB and DFB in order to bias the sensors and read the voltages.	EFI	derived	EFW-57,EFW-58	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-121	**EFW FSW B-Field Sampling**	The EFW FSW	shall	provide a module to collect MAG data	DFB	derived	EFW-35, EFW-207	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-122	**EFW FSW Deployment**	The EFW FSW	shall	provide a boom deployment module	DEP	derived	EFW-53,EFW-54, EFW-99, EFW-100	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-123	**EFW FSW EEPROM Loader**	The EFW FSW	shall	provide an EEPROM loader module	EEP	derived	EFW-114, EFW-123	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-124	**EFW FSW Fit Control**	The EFW FSW	shall	provide a module to collect EFW and MAG samples, perform Spin Fits and generate packets	FIT	derived	EFW-213	EFW-125, EFW-126, EFW-127, EFW-128, RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-125	**EFW FSW Spin Fitter**	The EFW FSW	shall	provide a Sine Wave Least Square Fitter	SPIN	derived	EFW-124	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-126	**EFW FSW Matrix Solving**	The EFW FSW	shall	provide a floating point matrix solver	MATRIX	derived	EFW-124	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-127	**EFW FSW Trigonometrics**	The EFW FSW	shall	provide a trigonometric package	TRIG	derived	EFW-124	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-128	**EFW FSW Floating Point**	The EFW FSW	shall	provide a high-speed floating point package	FFP	derived	EFW-124	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-129	**EFW FSW Compression**	The EFW FSW	shall	provide a compression module	CMP	derived	EFW-84	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-130	**EFW FSW Data Analysis**	The EFW FSW	shall	provide scientific analyses, space weather, burst event identification and data generation.	SCI	derived	EFW-13,EFW-32, EFW-37, EFW-204, EFW-213	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-214	**EFW Provide EMFISIS with Axial Shadowing Status**	The EFW FSW	shall	provide in "shared data" two bits of status which are commanded from the ground: when AXB is continuously in sun, intermittently in shadow, and continuously in shadow.	CMD, SCI	derived	EFW-208	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
EFW-217	**EFW FSW DC MAG Data**	The EFW FSW	shall	when commanded to do so, packetize and telemeter 64Hz MAG data in an unique APID	DFB, TM	derived	EFW-216	RBSP_EFW_FSW_002	T	FSW CPT	RBSP_EFW_FSW_024	RBSP_EFW_FSW_020C	Yes
				3.14 Power-on reset state									
EFW-131	**EFW Initial Power On/Reset State**	The EFW IDPU	shall	power up in a nominal condition for measuring E-Fields without processor intervention.		derived	EFW-36, EFW-93	RBSP_EFW_BPL_001	T	Instrument CPT	RBSP_EFW_INT_012	Instrument CPT Test Report	Yes
				3.15 Contamination control requirements									
EFW-132	**Instrument Compliance with Contamination Control Plan**	Each EFW Instrument	shall	comply with the requirements and constraints imposed by the RBSP Observatory Contamination Control Plan, APL document no. 7417-9011		Inherited	IPLD - 220	RBSP_EFW_PA_005	I, T	Inspections, Bakeout	MIL, RBSP_EFW_INT_016	Instrument TVAC Test Report	Yes
EFW-133	**Instrument Compliance with EM Environment Control Plan**	Each EFW Instrument	shall	comply with the requirements and constraints imposed by the RBSP Electromagnetic Environment Control Plan, APL document no. 7417-9018.		Inherited	IPLD - 218	RBSP_EFW_SPB_001, RBSP_EFW_AXB_001, RBSP_EFW_BPL_001	T	EMC Tests	EMECP Verification Matrix, RBSP_EFW_INT_014	EMECP Verification Matrix, Instrument EMC Test Report	Yes
EFW-135	**EFW ESC Control**	Each EFW Instrument	shall	comply with the UCB Electrostatic Cleanliness (ESC) Plan		derived	EFW-23	RBSP_EFW_SPB_001, RBSP_EFW_AXB_001, RBSP_EFW_SYS_015	T, D	EMC Instrument Testing	EMECP Verification Matrix	EMECP Verification Matrix, Instrument EMC Test Report	Yes
EFW-136	**Instrument Compliance with Environmental Design and Test Requirements Document**	Each EFW Instrument	shall	comply with the requirements and constraints imposed by the RBSP Environmental Design and Test Requirements Document, APL document no. 7417-9019.		Inherited	IPLD - 257, IPLD - 179 , IPLD - 118, IPLD - 199, IPLD - 219, IPLD - 298, EFW-6, EFW-7, EFW-8, EFW-201, EFW-202	RBSP_EFW_SPB_001, RBSP_EFW_AXB_001, RBSP_EFW_IDPU_001, RBSP_EFW_TE_001	T, D	Vibration, Shock, Thermal Vaccum, Static Load, Venting	RBSP_EFW_AXB_022 (Stacer TVAC), RBSP_EFW_AXB_026 (Whip TVAC), RBSP_EFW_AXB_020 (AXB Vibration), RBSP_EFW_AXB_041(AXB Tube Static Load), RBSP-SPB-PRO-102 (SPB TVAC), RBSP-SPB-PRO-103 (SPB Vibration)	RBSP_EFW_AXB_041 (AXB Static Load), RBSP-AXB-ICD-001E (AXB Venting), RBSP-SPB-ICD-001F (SPB Venting), RBSP-IDP-ICD-500C (IDPU Venting) & Completion of EDTRD Verification Matrix	Yes
EFW-137	**EFW Quality Assurance**	Each EFW Instrument	shall	comply with the RBSP Performance Assurance Implementation Plan, as modified by the Compliance Matrix		Contract	EFW-1	RBSP_EFW_SPB_001, RBSP_EFW_AXB_001, RBSP_EFW_IDPU_001, RBSP_EFW_PA_001	I	Inspections, Traveler Review	Travelers	Travelers	Yes

RBSP EFW Instrument Requirements Verification Matrix Document, RBSP_EFW_SYS_017G

ID	Req. Title	Subject	Priority	Requirement Body or Section Heading	Description / Clarification	Source Type	Rationale	*Impacts / Effects*	*Verification Method*	*Description of where Verification Met*	*Document / Procedure No.*	*Test Report showing Verification*	*Requirement Fully Met*
EFW-211	**Instrument Range Safety**	Each EFW Instrument	shall	comply with all relevant requirements and constraints imposed by AFSPC 91-710, Range Safety User Requirements Manual.		Inherited	IPLD - 577	RBSP_EFW_SPB_001, RBSP_EFW_AXB_001, RBSP_EFW_IDPU_001, RBSP_EFW_PA_001	I	MA-006 Input	MA-006 Input	MA-006 Input	Yes
EFW-212	**Observator Naming Convention**	Each EFW Instrument	shall	use an observatory naming convention, as follows: -- Observatory A is the top observatory in the stacked configuration for launch; -- Observatory B is the bottom observatory in the stacked configuration for launch.		inherited	IPLD - 555		I	Instrument Serial Numbers	Instrument Travelers, Visual Inspection	N/A	Yes

RBSP EFW -EMFISIS ICD Verification

ID	ICD Ref.	Object Text	EMFISIS	EFW	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
1	2.2	For purposes of this ICD, the Science Coordinate system shall be used for reference of all requirements within text, schematics and drawings.	X	X	X				EFW-EMFISIS ICD	EFW-EMFISIS ICD	Complete	Boom Numbering to Co-ordinate System included in EFW ICD.
2	2.3.1.1	Each EFW instrument shall be capable of providing buffered, analog probe voltage difference signals to Waves interface port J503 for two orthogonal pairs of spin plane electric field sensors connected directly to the EMFISIS Waves instrument, module 500, with signal characteristics as follows: Frequency Range 1: -- frequency range: from 10 Hz to 12 kHz; -- sensitivity: 3.10-14 (V/m)2/Hz at 1 kHz; -- bandwidth: 175 Hz; -- dynamic range: 100 dB. Frequency Range 2: -- frequency range: from 10 kHz to 400 kHz; -- sensitivity: 3.10-17 (V/m)2/Hz at 100 kHz; -- bandwidth: 7 kHz; -- dynamic range: 100 dB; • maximum signal amplitude: *50 mV/m at 1 kHz. *STARD value = 30 mV/m at 1 kHz – interface meets STARD		X		X			EFW Timing, Phasing and Noise Test, EFW-EMFISIS I/F Test	Test Reports for procedures (RBSP_EFW_TR_027 and RBSP_EFW_TR_035)	Complete	IPLD-245, EFW-36
3	2.3.1.1	Note: See figure 2-3 (for informational purposes only; the required interface levels are given in the text). For the axial component signals (next section) these requirements shall be reduced by a factor of 100 in sensitivity and 20 dB in dynamic range.		X		X			EFW Timing, Phasing and Noise Test, EFW-EMFISIS I/F Test	Test Reports for procedures (RBSP_EFW_TR_027 and RBSP_EFW_TR_035)	Complete	IPLD-245, EFW-36
4	2.3.1.2	EMFISIS Waves instrument shall be capable of receiving buffered, analog spin axis electric field measurement through Waves interface J503 directly from the EFW instrument, with signal characteristics as follows: Frequency Range 1: -- frequency range: from 10 Hz to 12 kHz; -- bandwidth: 175 Hz; -- dynamic range: 80 dB; -- sensitivity: 3.10-12 (V/m)2/Hz at 100 Hz. Frequency Range 2: -- frequency range: from 10 kHz to 400 kHz; -- bandwidth: 7 kHz; -- dynamic range: 80 dB; -- sensitivity: 3.10-15 (V/m)2/Hz at 100 kHz; • maximum signal amplitude: 50 mV/m at 1 kHz. *STARD value = 30 mV/m at 1 kHz – interface meets STARD requirements with more capability • signal output impedance: 20 ohms	X	X		X			EFW Timing, Phasing and Noise Test, EFW-EMFISIS I/F Test	Test Reports for procedures (RBSP_EFW_TR_027 and RBSP_EFW_TR_035)	Complete	IPLD-246, EFW-208

RBSP EFW -EMFISIS ICD Verification

ID	ICD Ref.	Object Text	EMFISIS	EFW	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
5	2.3.1.3	EMFISIS instrument shall be capable of delivering 3D buffered analog search coil signals to the EFW from the Waves instrument port J503, with signal characteristics as follows: -- frequency range: 10 Hz to 300 Hz ; -- noise floor: ≤ 1 x10-06 (nT)2/Hz at 100 Hz -- dynamic range: 90 dB. • maximum signal amplitude: +/-5V (w/ no excursions) • signal load impedance: 200K ohms • signal output impedance: 20 ohms	X									IPLD-253, EMFISIS-41
6	2.3.1.4	EMFISIS instrument shall be capable of delivering DC-coupled, 3-axis data to the EFW from MAG instrument module 700: through an analog interface connected to J703; with signal characteristics as follows: -- frequency range: from DC to 30 Hz; -- noise floor: ≤ 2 nTRMS ; -- dynamic range: 0 to +/-65536 nT; 0 to +/-4096 nT ; 0 to +/-256 nT • maximum signal amplitude: +/-5V (*w/ excursions up to +/-6.8V) *Note: duration of an excursion is indefinite and will occur infrequently, representative of an off-nominal condition. When	X									IPLD-254, EMFISIS-42
7	2.5	All interface circuits should meet these requirements: 1. Shall tolerate the case where the receiver is powered off while the driver is powered on (and vice versa) indefinitely 2. Shall power up properly independent of which system is powered up first (i.e. power pulled from the powered system by the unpowered system off the signal lines cannot prevent the unpowered system from powering up properly) 3. Shall protect the drivers and receivers against DDD events in the EFW to EMFISIS harness (per 7417-9018) 4. Shall limit current returned through the chassis ground (connected to signal ground in both EMFISIS and EFW). Differential receivers shall return DC, and to the extent possible AC	X	X		X			EFW Noise and Timing Test, EFW-EMFISIS Test	Test Reports for procedures (RBSP_EFW_TR_027 and RBSP_EFW_TR_035)	Complete	
8	2.5.1	Figure 2-6 shows the analog circuitry that EFW shall use to distribute electric field signals from the EFW instruments to the EMFISIS instruments.		X	X				BEB Board Requirements (RBSP_EFW_BEB_001)	BEB Board Schematics (RBSP_EFW_BEB_SCH_002)	Complete	
9	2.5.3	Figure 2-9 and Figure 2-10 show the analog circuitry that EMFISIS shall use to distribute fluxgate and search coil magnetometer signals, respectively, from the EMFISIS instruments to EFW instruments.	X									EMFISIS Requirement
10	2.5.4	Figure 2-11 shows the analog input circuitry EMFISIS shall use to receive EFW E-Field signals, respectively, from the EFW instruments to EMFISIS instruments.	X									EMFISIS Requirement
11	2.6	The EMFISIS and EFW interface shall comply with specific requirements contained within the RBSP EMECP (Doc, 7417-9018).	X	X		X			EFW EMC Test Procedure	EFW EMC Test Report (RBSP_EFW_TR_030)	Complete	

RBSP EFW -EMFISIS ICD Verification

ID	ICD Ref.	Object Text	EMFISIS	EFW	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
12	2.7.1	EFW shall build the EFW to EMFISIS harnesses.		X	X				EFW Harness Assembly Documentation	Harness Built and Installed on S/C	Complete	
13	2.7.4	The EFW-EMFISIS interface harness design will comply with mission-level requirements on the mitigation of the effects of bulk charging events, radiation shielding, and EMI/EMC (7417-9018). In addition, each line shall follow a similar strategy for providing a low-noise, well shielded interface, namely the use of shielded twisted-pair or coax conductors to provide both a signal and reference ground level for each of the signal lines, as well as a well-defined, source-end-terminated, sink-end-isolated shield for each signal (Twisted shielded pairs only).	X	X	X				EFW Harness Assembly Documentation		Complete	Note that metallic-coated fiber braid now replaced with tape.

RBSP EFW EDTRD Verification															
	EDTRD Revision Used	**Revision A**													
				Level of Assembly/Ver Method											
Req#	**Parameter/ Req Title Section**	**Requirement**	**Section**	Subassembly	Assembly	Instrument Component	Suite	Observatory	Verification Method	**Verification Description**	**FM#1**	**FM#2**	**Verification Closed/Date**	**Responsible Organization**	**Notes / Comments**
Instruments															
EDTRD -1	General Mission Information, Applicable Documents and Verification Program	All spacecraft bus and instrument subsystems and components **shall** be designed to meet performance specifications under the conditions of humidity, pressure, temperature, vibration, acoustic, shock, radiation, and EME as defined in EDTRD.	2	T	T	T		T	T	Environmental Test Program. Vibration Test reports, TVAC Test reports, EMC Test reports	Y	Y	15-Jun-11	SSL	
EDTRD -2	General Mission Information, Applicable Documents and Verification Program	The spacecraft hardware **shall** be tested at the component or subsystem level as specified in EDTRD.	2	T	T	T		T	T	Environmental Test Program. Vibration Test reports, TVAC Test reports, EMC Test reports	Y	Y	15-Jun-11	SSL	
EDTRD -3	General Mission Information, Applicable Documents and Verification Program	For each spacecraft and instrument component and subsystem, the adequacy of the design to perform in these environments **shall** be demonstrated at the hardware design reviews.	2	I	I	I		I	I	PDR, CDR, PER & PSR Materials	Y	Y	15-Jun-11	SSL	
EDTRD -4	General Mission Information, Applicable Documents and Verification Program	The performance **shall** be established through a verification test plan (which incorporates the requirements of this specification), verification matrix, a verification test procedure, a verification test, and a verification test report.	2	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -5	Phases of the Mission	Observatories and Ground Equipment **shall** operate within the constraints imposed by the Pre-Launch environment.	2.1.2	T	T	T		T	T	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -6	Phases of the Mission	Observatories **shall** survive and operate through the LV ascent and separation environment.	2.1.2	T	T	T		T	T	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -7	Change and Conflict Control	In case of conflict with spacecraft component and subsystem documents, the requirements of this specification **shall** govern unless program level exemption is granted.	2.5							N/A					
EDTRD -8	Change and Conflict Control	Conflicts with program and mission level documents that result in changes to the agreed observatory requirements **shall** not be implemented until negotiated with APL	2.5							N/A					
EDTRD -9	Verification Program	Verification **shall** occur through test, demonstration, analysis, inspection or any combination.	2.6.1						I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -10	Verification Program	Verification methods **shall be** documented in the system level test and verification plans.	2.6.1						I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -11	Verification Program	Observatory component, instrument and subsystem workmanship and performance **shall be** verified by demonstrating specification compliance before, during and after application of the environmental stresses.	2.6.1	T	T	T		T	T	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -12	Verification Program	The component **shall be** tested to the expected environmental exposure plus margin.	2.6.1	T	T	T		T	T	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -13	Verification Program	The verification program **shall** begin informally with testing of assemblies, where details on the tests conducted and the results obtained are recorded in lead engineer's logbooks.	2.6.1						I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -14	Verification Program	The formal verification program **shall** begin at the component level of assembly.	2.6.1						I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -15	Verification Program	Test plans, procedures, and reports **shall be** written for each component and subsystem test, as appropriate, and for observatory level testing.	2.6.1						I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -16	Test Plan	A test plan and procedure, incorporating the requirements of this specification, **shall be** written for each observatory (spacecraft bus and instrument) component level of assembly and higher. It **shall be** a controlled document, which outlines the overall verification approach to demonstrate hardware compliance with the hardware specifications.	2.6.2	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	

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	Instruments														
EDTRD -17	Test Plan	Test plans for hardware **shall** include the following items for all hardware (unless otherwise specified). The test plans **shall** provide a level of detail sufficient to enable meaningful review by persons not directly involved in the development of the item to be tested. If information required by the test plan is captured in other program documentation, the test plan should reference that document rather than duplicating it in the test plan. • A brief technical description of the test item and the test objectives. • Parameters to be verified and whether verification is to be by inspection, test, analysis or demonstration. • A description of the test flow (including test profiles, sequence of tests and time span required) • The hardware test configuration, including: a. Test setup for item under test, b. Test facilities required (shake table, chambers, etc), c. Standard test equipment required, and d. Hardware unique test equipment. • Overview and/or list of fixtures and special hardware required during test (nitrogen purge, etc.). • Instrumentation requirements • Tests to be performed, both functional and environmental (specify where baseline, full performance and limited performance tests are required). • Special conditions required of test facility (e.g., contamination control, magnetic compensation requirements). • Plans for handling limited life items (including the life limit and projected use), sensitive and one-time use items • Identification of parameters to be tracked for trend analyses. • Accept/reject criteria • References to significant applicable program documents (gives requirements and traceability) • General integration and test policies and procedures (system level test plan) • List of critical procedures (system level test plan) • Processes employed to protect the hardware under test (system level test plan) • A listing of any exceptions taken to the provisions of this document • Exceptions to "test as you fly; fly as you test" • A summary of major moves, transport equipment and logistical support (system level test plan)	2.6.2.1	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -18	Test Plan	Analysis plans **shall** include: • The objective. • A description of the mathematical model used. • Assumptions on which the model is based. • The criteria for accepting the results. • The documentation of the required results.	2.6.2.1							N/A					
EDTRD -19	Test Procedure	A test procedure, which implements the above plan **shall** be developed (diagrams should be included as much as possible). These **shall** be developed in enough detail to cover all aspects of a test, including test article and test equipment configuration; pass/fail criteria and test parameters with acceptable minimum and maximum limits; instrumentation configuration; and data collection requirements. The test procedures should also address measures to be taken to maintain safety, control contamination, and protect the test hardware from damage. Test procedures **shall** include the following content: • Statement of test objectives. • Details for implementing each test activity. • Test sequences. • Description of test configuration. • Performance parameters and operating characteristics to be tested. • Detailed procedure for method of measuring the applicable performance parameters. • Data collection sheets (or method of collecting the data). • Nominal values and tolerances (accept/reject) of performance parameters and operating characteristics to be measured. • A specification verification matrix including each parameter tested and the specification item being verified. • Safety and contamination control provisions as applicable. • Test equipment to be used and details of operating equipment for the tests. • Operations to be performed by the test operator, including operational checks and calibration of the test equipment, as necessary. • Conditions that shall be maintained during test, including ambient or environmental conditions, and precautions to be observed to prevent injury to personnel or damage to the articles or instruments involved. • Current calibration due date of Class 1 test equipment. • Identification of software to be used, if computer controlled tests are planned. • Abort procedures. • Sign off sheets for test engineers and test conductors. • Log of number of test hours • Departures from flight configuration • Hazardous operations shall be clearly identified	2.6.2.2	I	I	I		I	I	Written Test Procedures	Y	Y	15-Jun-11	SSL	
EDTRD -20	Test Log	A Test Log (sometimes referred to as the Engineering Notebook) **shall** be maintained that provides a record of the test activities performed on the component, subsystem, or instrument. The log **shall** include, at a minimum: • Identification of the activity or test • Identification of the designated test conductor for the activity • Start and completion times for the activity • All modifications and deviations from procedures • Component power-on and power-off events • Changes to the GSE configuration during testing • All off-nominal events, along with a reference to any associated anomaly reports, problem failure reports, or software change requests generated • All entries in the log **shall** be timed-tagged and initialed by the author.	2.6.2.3.	I	I	I	I		I	Assembly and Instrument Binders	Y	Y	15-Jun-11	SSL	

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Instruments															
EDTRD -21	Test Report	The report documents and provides traceability to the tests on the flight hardware. The report **shall** contain: • Purpose of test • Test setup • Test date(s) • Test specification(s) and/or procedure(s) used to execute the test and reference to the as-run procedure, which should include staff responsible who executed the test and test facilities used. • Summary or list of deviations from the test specification and/or procedure • Summary or list of problems, anomalies, or failures that occurred during testing, including references to any problem/failure reports generated • Exceptions to "test as you fly; fly as you test". • Brief (1-2 paragraph) test overview with summary statement of pass or fail • All test data and results, or a reference to the location where the data and/or results can be found • Test equipment used and calibration status (if applicable) • Record of the data sheets and documented results of the required acceptance tests • Any formulas used for analyses • Copies of the run status (if applicable) • Whether the test was a success or failure • Compliance matrix that compares the test item performance parameters to the required specification • Pictures of the test setup and test article under testing (when practical)	2.6.2.4.	I	I	I		I	I	EIDP	Y	Y	18-Nov-11	SSL	
EDTRD -22	Verification Matrix	A verification matrix will be developed and provided in parallel with this document that specifies for each component/subsystem the specific test and method of verification that each hardware **shall** complete. Spacecraft and instrument teams **shall** verify their hardware per this matrix.	2.6.2.5.	I	I	I		I	I	RBSP_EFW_SYS_017					
EDTRD -23	Order of Testing	Verification testing for all hardware **shall** follow the types of tests and typical sequence of testing shown in Table 2.2 of the EDTRD	2.7.1	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -24	Order of Testing	Deviations from this defined sequence of testing **shall** be brought to the attention of APL and specified with noted changes in the test flow and the rationale for the change in the test plan for the item under test.	2.7.1	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -25	Mechanical Compliance	Compliance for size, mass properties, etc., **shall** be verified against the hardware specification.	2.7.2	T	T	T		T	T	Mass Properties Reports	Y	Y	15-Jun-11	SSL	
EDTRD -26	Electrical Integration Tests	Prior to integration of the component, subsystem or instrument into the next higher hardware assembly, electrical integration tests **shall** be performed to verify that all interface signals are within acceptable limits of the applicable performance specifications.	2.7.3.	I	I	I		I	I	Safe to Mate Procedures as appliacable	Y	Y	15-Jun-11	SSL	
EDTRD -27	Electrical Integration Tests	Before being mated with other hardware, electrical harnessing **shall** be tested to verify proper characteristics, such as routing of electrical signals/power, impedance, isolation, and overall workmanship.	2.7.3.	I	I	I		I	I	Safe to Mate Procedures as appliacable	Y	Y	15-Jun-11	SSL	
EDTRD -28	Electrical Integration Tests	Below the level of integration onto the observatory, the test results **shall be** kept in the lead engineer's logbook.	2.7.3.	I	I	I		I	I	Completed Safe to Mate Procedures in EFW Travelers	Y	Y	15-Jun-11	SSL	
EDTRD -29	Electrical Integration Tests	For integration onto the observatory formal integration procedures **shall be** written to detail these tests.	2.7.3.	I	I	I		I	I	EFW to S/C Safe to Mate procedure, 9417-8773	Y	y	15-Jul-11	APL	
EDTRD -30	Electrical Performance Tests	Performance tests **shall** be conducted on each hardware element upon completion of integration at the component or subsystem level, as appropriate, and at the observatory level.	2.7.4.	I	I	I		I	I	EFW Travelers & CPT Reports at Observatory Level	Y	Y	15-Jun-11	SSL	
EDTRD -31	Electrical Performance Tests	Before environmental exposure, baseline performance tests **shall** be performed at ambient temperature and pressure for comparison to post environmental exposure and to later performance.	2.7.4.	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -32	Electrical Performance Tests	For environmental testing, performance tests **shall be** conducted prior to and at the conclusion of environmental test sequences, as well as at the other times prescribed in the hardware test plan, procedure or in this document.	2.7.4.	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -33	Electrical Performance Tests	Performance tests **shall be** conducted for all components during component level TV testing.	2.7.4.	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -34	Electrical Performance Tests	During component level vibration testing, all spacecraft and instrument components **shall be** powered (unless there is an identified potential for damage and waiver is obtained) and selected parameters monitored.	2.7.4.						N/A	Waiver Approved RBSP_EFW_CCR_005					

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Instruments															
EDTRD -35	Electrical Performance Tests	At a minimum, those circuits that are powered during launch **shall be** powered during vibration testing.	2.7.4.						N/A	EFW Off during launch.					
EDTRD -36	Electrical Performance Tests	At Observatory level vibration, shock and acoustic testing, spacecraft components **shall be** powered (unless there is potential for damage).	2.7.4.						N/A	Waiver Approved RBSP_EFW_CCR_005					
EDTRD -37	Electrical Performance Tests	At a minimum, the spacecraft critical components (on at launch, see Appendix A) **shall be** powered and placed in launch configuration	2.7.4.						N/A	EFW Off during launch.					
EDTRD -38	Electrical Performance Tests	The details of performance tests at the component and subsystem level **shall be** given in individual spacecraft and instrument hardware test plans.	2.7.4.	I	I	I		I	I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -39	Limited-Life Item Considerations	Spacecraft and instrument lead engineers **shall** identify limited-life-items.	2.7.7.	I	I	I		I	I	Limited Life item submission	Y	Y	15-Jun-11	SSL	
EDTRD -40	Limited-Life Item Considerations	For hardware with life limited items, the test plans and procedures **shall** address the life test program for the limited life items. It **shall** indicate the elements that require such testing, describing the test hardware that will be used, and the test methods that will be employed.	2.7.7.						N/A						
EDTRD -41	Limited-Life Item Considerations	A record of on-time or number of mechanical actuations for limited life components **shall be** kept starting at the first application of power or mechanical actuation of that component.	2.7.7.	I	I	I		I	I	Contained in EFW Travelers	Y	Y	15-Jun-11	SSL	
EDTRD -42	Limited-Life Item Considerations	Verification of useful life by analysis, instead of or in addition to testing, **shall be** supported by suitable rationale.	2.7.7.						N/A						
EDTRD -43	Total Ionizing Doze	All parts used in RBSP observatory **shall** survive a total ionizing dose of 34 krads (Si) [23 krads (Si) for the IEM, 100 krads (Si) for the Propulsion Diode Box (PDB) and Bleed Resistor Box (BRB)] without parametric or functional failure.	3.1.1.	I	I	I		I	I	EFW Parts List	Y	Y	15-Jun-11	SSL	
EDTRD -44	Total Ionizing Doze	The figures also show that EEE parts cannot be shielded below an intrinsic hardness level of 20 krads (Si) and **shall not be** susceptible to total dose effects below this minimum value.	3.1.1.						I	EFW Parts List	Y	Y	15-Jun-11	SSL	All parts meet the 20kRad requirement.
EDTRD -45	Total Ionizing Doze	A waiver to use EEE Parts with total dose susceptibility of less than 34 krads (Si) [23 krads (Si) for the IEM, 100krads (Si) for the PDB and BRB] may be granted, if one of the following criteria is met: • Part failure is shown to occur between 20 and 34 krads (Si) [23 krads for the IEM] and the failure mode is a non-critical one, i.e., the part continues to function up to 34 krads (Si) [23 krads for the IEM] but certain parametric values that exceed the manufacturer's specifications can be derated for the circuit design. • Appropriate spot shielding is added around the part so that the combination of part hardness and shield thickness will survive 51 krads (Si) [35 krads for the IEM]. An RDM of X3 is used for spot-shielded parts. • A three dimensional shielding analysis is performed to verify that the susceptible part will withstand the expected local total dose. The analysis is subject to review and approval of the RBSP Radiation Engineer. In each case, a waiver request and explanation **shall** be submitted to the JHU/APL Radiation Engineer with notification to RBSP Parts Control Board.	3.1.1.						N/A						
EDTRD -46	Total Ionizing Doze	The connector cutouts in chassis **shall be** shielded to prevent localized high ionizing doses inside electronics boxes. This shielding may be inside or outside of the electronics box. For instances where this shielding is outside the box volume, interface information **shall be** communicated to the spacecraft for proper accommodations.	3.1.1.		D				D	IDPU ICD	Y	Y	15-Jun-11	SSL	
EDTRD -47	Displacement Damage	Solar panels and instrument optics or exposed detectors **shall** withstand displacement damage associated with trapped proton fluence. Figure 3-3 shows the expected 10 MeV equivalent proton fluence as a function of shield depth in aluminum. For the box wall thicknesses of 350-500 mils the fluences are in the range of 5 X1010 to 8 X 1010 p/cm2. This curve will be used to guide the displacement damage testing.	3.1.2.							N/A					

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Instruments															
EDTRD -48	Single Event Effects	The "Worst Week" environment curve is generally used in upset rate calculations. It shall be combined with the experimentally determined upset cross section for a given device to calculate the upset rate.	3.1.3.	A					A	Analysis for SEE used worse case flux predictions	Y	Y	15-Jun-11	SSL	
EDTRD -49	Single Event Latch-up	Parts susceptible to single event latch-up with linear energy transfer threshold less than 80 MeVsq cm/mg **shall not be** used in RBSP systems.	3.1.3.1							EFW Parts List	Y	Y	15-Jun-11	SSL	Waivers CCR_001 and CCR_002 submitted and accepted for two parts that don't meet this requirement.
EDTRD -50	Single Event Upsets (SEU)	A Failure Modes and Effects Analysis **shall be** performed to demonstrate that Single Event Upsets (SEU) in parts used in critical systems (e.g. power generation, C&DH, RF) **shall not** cause mission critical failures.	3.1.3.2.						N/A						
EDTRD -51	Single Event Upsets (SEU)	SEUs in parts of non-critical systems **shall not** compromise flight system health or mission performance.	3.1.3.2.	T					T	EFW Parts List, Interface FMEA	Y	Y	15-Jun-11	SSL	
EDTRD -52	Single Event Upsets (SEU)	Parts that may be susceptible to SEU **shall be** identified by the submitter and/or the RBSP Parts Control Board, and submitted with the preliminary parts list to the APL RBSP Radiation Engineer for review.	3.1.3.2.	I					I	Parts submitted to PMPCB	Y	Y	15-Jun-11	SSL	
EDTRD -53	Peak Charged Particle Fluxes	Hardware **shall** operate through the peak charged particle fluxes given in Table 3 2, Table 3 3 and Table 3 4.	3.1.3.3.	A					A	Analysis for SEE used worse case flux predictions	Y	Y	15-Jun-11	SSL	
EDTRD -54	RBSP Parts Radiation Test Plans for Spacecraft and Instrument Components	Three types of radiation evaluation/qualification testing are anticipated for spacecraft and instrument parts. Susceptible parts **shall be** identified to the APL RBSP Radiation Engineer.	3.1.4.	I					I	Parts submitted to PMPCB	Y	Y	15-Jun-11	SSL	
EDTRD -55	RBSP Parts Radiation Test Plans for Spacecraft and Instrument Components	• High Dose Rate Total Ionizing Dose (TID) Testing: These evaluation and qualification tests will be primarily conducted by APL at a dose rate of 25 rads (Si)/second. Electrical tests (parametric and functional) shall be executed before the start of the test, at several selected intervals during the exposures (i.e. 10, 20, 50 krads), at the completion of the radiation exposure and following a one-week anneal at 100 deg C.	3.1.4.	I					I	Parts submitted to PMPCB	Y	Y	15-Jun-11	SSL	
EDTRD -56	RBSP Parts Radiation Test Plans for Spacecraft and Instrument Components	Vendors shall be responsible for qualifying their hardware; instrument designers may receive assistance from APL, on a case-by-case basis.	3.1.4.	I	I	I			I	TE-001	Y	Y	15-Jun-11	SSL	
EDTRD -57	RBSP Parts Radiation Test Plans for Spacecraft and Instrument Components	Single Event Effects Evaluation and Testing: All devices analyzed to be susceptible to latch-up by their architecture **shall be** screened for latch-up immunity to a linear energy threshold of 80 MeV-sq cm/mg using heavy ions at Brookhaven National Laboratory, Texas A&M University or another agreed upon facility.	3.1.4.	T					T	SEE Testing	Y	Y	15-Jun-11	SSL	
EDTRD -58	RBSP Parts Radiation Test Plans for Spacecraft and Instrument Components	• Proton Displacement Damage Testing: The mission orbit results in high proton fluence (1.99 X 1012 p/cm2 greater than 10 MeV incident on the surface of the spacecraft). Proton displacement damage testing of the devices known to be susceptible to these effects shall be conducted.	3.1.4.						N/A						
EDTRD -59	Deep Dielectric Discharge	Parts, assemblies and components **shall** either have to survive discharge, be grounded with low enough impedance to prevent charging, or shield with enough material to reduce the total accumulated charge below discharge level.	3.2.	A & T						DDD Analysis and Tests	Y	Y	15-Jun-11	SSL	
EDTRD-164	Instrument Design and Test Requirements	Prior to instrument acceptance for integration on the observatory, the instrument documentation **shall** provide proof of verification that the instrument can survive and operate within specifications, as applicable, for the environments given in this section and shall not produce a hazard to other hardware on the observatory.	5	I	I	I			I	EFW Travelers.	Y	Y	15-Jun-11	SSL	
EDTRD-165	Instrument Design and Test Requirements	The hardware **shall be** subjected to bakeout as required by 7417-9011 RBSP Observatory Contamination Control Plan.	5			T			T	Completed EFW Instrument Thermal Vacuum Procedure	Y	Y	15-Jun-11	SSL	
EDTRD-166	Instrument Design and Test Requirements	Instrument hardware **shall be** designed to the requirements given in this section	5	D	D	D			D	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-167	Instrument Design and Test Requirements	Throughout testing, each instrument subsystem or instrument component **shall be** powered unless there is an identified potential for damage and a waiver has been obtained from APL.	5						N/A	Waiver Approved RBSP_EFW_CCR_005					
EDTRD-168	Instrument Design and Test Requirements	Any instrument or part of an instrument powered during launch, **shall be** vibrated in a powered configuration. Table 5-2 gives a template for the verificataion requirements matrix.	5						N/A	N/A					

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Instruments																
EDTRD-169	Instrument Design and Test Requirements	Instrument specific stimuli and related test equipment, as applicable, **shall be** supplied by the instrument team, including documentation and any special cautionary notes.	5			T		T	T	Boom Load Box delivered with instrument	Y	Y	15-Jun-11	SSL		
EDTRD-170	Instrument Design and Test Requirements	Verification of design for deploying mechanisms shall be conducted over temperature	Table 5-2, note 2		T				T	SPB and AXB Deployments in Themal Vacuum	Y	Y	15-Jun-11	SSL		
EDTRD-171	Instrument Design and Test Requirements	Shock testing requirements for instruments are restricted to self induced shock from instrument deployables. Testing of deployables shall be included in instrument testing. Shock levels shown in Table 5-8 and 5-9 are induced on the observatory by separation systems at each of the separation system interfaces.	Table 5-2, note 5		T				T	SPB and AXB Deployments	Y	Y	15-Jun-11	SSL		
EDTRD-172	Instrument Integration with Spacecraft	Purge requirements **shall be** specified in each instrument's ICD.	5.2.						N/A							
EDTRD-173	Instrument Thermal Design Environment	Instruments **shall be** designed to operate within specifications for the science phase of the mission and not suffer permanent degradation during any other phase of the mission.	5.3.1.		T	T			T	Instrument Thermal Vacuum Procedure	Y	Y	15-Jun-11	SSL		
EDTRD-174	Instrument Thermal Design Environment	Details for thermal model exchanges and requirements shall be specified in each instrument's Contract Deliverables Requirements List.	5.3.1.		I	I			I	Thermal Predicts Delivered	Y	Y	15-Jun-11	SSL		
EDTRD-175	Instrument Thermal Design Environment	Instrument components shall demonstrate the ability to turn on at the survival temperature extremes without damage or degradation	Table 5-4, note 1		T	T			T	Instrument Thermal Vacuum Procedure	Y	Y	15-Jun-11	SSL		
EDTRD-176	Instrument Thermal Design Environment	Isolated instrument components shall demonstrate a total thermal interface resistance (conductive and radiative) of at least 20 □ analysis and test.	Table 5-4, note 2							N/A						
EDTRD-177	Instrument Thermal Design Environment	Instruments thermally coupled to the spacecraft shall be designed such that the heat density at their mounting surfaces does not exceed 387 Watts/m2 (0.25 W/in2)	Table 5-4, note 2		A	T			A & T	Instrument Thermal Vacuum Procedure & IDPU ICD	Y	Y	15-Jun-11	SSL		
EDTRD-178	Instrument Thermal Design Environment	Coupled instruments shall have Cho-seal between the component baseplate and spacecraft mounting surface.	Table 5-4, note 3			I		I	I	APL supplied the Cho-seal during mechanical integration per 7417-9409 and 7417-1386	Y	Y	15-Jun-11	APL		
EDTRD-179	Instrument Thermal Testing Requirements	Instruments **shall** complete a successful thermal vacuum flight qualification testing program prior to delivery to the spacecraft.	5.3.2.		T	T			T	Instrument Thermal Vacuum Procedure	Y	Y	15-Jun-11	SSL		
EDTRD-180	Instrument Thermal Testing Requirements	The program **shall** consist of thermal vacuum balance and thermal vacuum cycle testing.	5.3.2.		I	I			I	TE-001	Y	Y	15-Jun-11	SSL		
EDTRD-181	Instrument Thermal Testing Requirements	All instrument thermal test plans/procedures **shall be** provided to the Spacecraft Thermal Engineer for review and approval.	5.3.2.		I	I			I	Thermal Vacuum procedures submitted to APL prior to run	Y	Y	15-Jun-11	SSL		
EDTRD-182	Thermal Balance Testing Requirements	Each thermally isolated instrument shall perform thermal vacuum balance testing to correlate its thermal performance to thermal model predictions.	5.3.2.1.						N/A	N/A						
EDTRD-183	Thermal Balance Testing Requirements	There is no requirement for thermal balance testing of identical thermal designs of the same instrument. The thermal hardware for these instruments forgoing the thermal balance test shall demonstrate in thermal cycling that all thermal hardware works as expected.	5.3.2.1.						N/A	No TB test						
EDTRD-184	Thermal Balance Testing Requirements	The test shall simulate spacecraft conductive and radiative interface temperatures, space radiation couplings, and environmental heat inputs	5.3.2.1						N/A	No TB test						
EDTRD-185	Thermal Balance Testing Requirements	The instrument thermal control system **shall** demonstrate the ability to maintain temperatures within survival limits while in non-operating mode and within operational limits while in operating mode.	5.3.2.1.					T		S/C Thermal Balance Test						
EDTRD-186	Thermal Balance Testing Requirements	Instruments **shall** demonstrate via testing that survival heaters do not turn on during normal operational mode.	5.3.2.1.						N/A	No Heaters on EFW - N/A						
EDTRD-187	Thermal Balance Testing Requirements	Flight predictions **shall** demonstrate at least 10°C of margin within the operational or survival design limits, as appropriate, based on a thermal balance correlated model, with the exception that for active heater control, 5°C of temperature margin is acceptable at the lower design limit.	5.3.2.1.	A	A	A			A	Thermal Predicts	Y	Y	15-Jun-11	SSL		
EDTRD-188	Thermal Balance Testing Requirements	Instrument survival and operational temperature limits **shall** be specified in the Instrument Interface Control Document.	5.3.2.1.			I			I	See Themal Balance Test Report, SEM-12-4-498 and EFW ICD, 7417-9083	Y	Y	15-Jun-11	SSL		
EDTRD-189	Thermal Cycle Testing Requirements	The test **shall** include six powered operational cycles and one survival cycle.	5.3.2.2.			T			T	Instrument Thermal Vacuum Test Report	Y	Y	15-Jun-11	SSL		

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	EDTRD Revision Used	**Revision A**													
				Level of Assembly/Ver Method											
Req#	**Parameter/ Req Title Section**	**Requirement**	**Section**	Subassembly	Assembly	Instrument Component	Suite	Observatory	Verification Method	**Verification Description**	**FM#1**	**FM#2**	**Verification Closed/Date**	**Responsible Organization**	**Notes / Comments**
		Instruments													
EDTRD-190	Thermal Cycle Testing Requirements	Component turn-on **shall be** demonstrated at the hot and cold plateaus of the first and last operational cycles.	5.3.2.2.			T			T	Instrument Thermal Vacuum Test Report	Y	Y	15-Jun-11	SSL	
EDTRD-191	Thermal Cycle Testing Requirements	Dwell time at the hot and cold plateaus will depend on the component being tested. The duration shall be long enough to ensure that all internal parts reach a stable temperature with the power on.	5.3.2.2.			T			T	Instrument Thermal Vacuum Test Report	Y	Y	15-Jun-11	SSL	
EDTRD-192	Thermal Cycle Testing Requirements	Prior to opening the chamber the test operator shall assure that the box temperature is sufficiently warm (relative to ambient temperature and humidity) to prevent condensation.	5.3.2.2.			T			T	Instrument Thermal Vacuum Test Report	Y	Y	15-Jun-11	SSL	
EDTRD-193	Thermal Cycle Testing Requirements	CPT's shall be conducted during instrument level TV testing. Shows recommended locations for these CPTs. Minimal functional tests shall be performed at all remaining plateus.	Figure 5-1, note 1			T			T	Instrument Thermal Vacuum Test Report	Y	Y	15-Jun-11	SSL	
EDTRD-194	Transient Environments Before Fairing Release	Due to aerodynamic heating during ascent, the payload fairing exposes the spacecraft to a transient thermal environment. All instruments **shall be** able to survive these transient environments without degradation. For the RBSP Atlas V-401 launch vehicle, the peak heat flux radiated by the 4-m fairing inner surfaces is less than 400 W/m2 (125 BTU/hr-ft2) and peak fairing skin temperatures remain below 204oC (400oF). Inner acoustic blanket temperatures remain below 49oC (120oF).	5.3.3.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-195	Transient Environments After Fairing Release	Transient environments due to the LV fairing release occurs while some residual atmosphere exists, allowing atmosphere to interact with the spacecraft in the free-molecular flow regime and can cause transient heating. All instruments **shall** be able to survive, without degradation, the heating environment they will be exposed to following fairing release.	5.3.4.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-196	Transient Environments due to 2nd Stage Firing	The launch vehicle 2nd stage motor subjects the spacecraft to a thermal influence during motor burns. Instruments within the realm of influence of this heating (at or near the spacecraft to launch vehicle interface or with some radiative view of the 2nd stage) shall survive this heating without degradation.	5.3.5.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-197	Instrument Structural Design and Test Requirements	Instruments **shall be** designed to the requirements given in this section	5.4.	D					D	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-198	Instrument Design Load Factors	Instrument components and subsystems shall be designed to the following limit loads (maximum expected loads) shown in Table 5 5 and Table 5 6 multiplied by the appropriate material factor of safety.	5.4.1.	D					D	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-199	Instrument Design Load Factors	The design loads **shall be** applied separately in three orthogonal axes to the component center of gravity.	5.4.1.	D					D	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-200	EFW Axial Boom Static Load Testing	Due to the unique interface between the RBSP primary structure and EFW axial boom tube, the tube **shall be** treated as a piece of spacecraft structure that EFW shall provide as part of the RBSP AXB instrument.	5.4.1.2.	D	D				D	AXB ICD	Y	Y	15-Jun-11	SSL	
EDTRD-201	EFW Axial Boom Static Load Testing	Following assembly of these tubes, EFW **shall** thermally cycle them in accordance with section 5.3.2.	5.4.1.2.		T				T	AXB Tube Thermal Vacuum Report	Y	Y	15-Jun-11	SSL	
EDTRD-202	EFW Axial Boom Static Load Testing	The tubes shall then be static load tested by EFW to the loads specified below in Table 5-6.	5.4.1.2		T				T	AXB Tube Static Load Test Report	Y	Y	15-Jun-11	SSL	
EDTRD-203	EFW Axial Boom Static Load Testing	The structural integrity of the composite tubes and structural bonds shall be verified by pre-thermal cycling and post static load testing evaluations (ie - singnature sweep, ultrasonic NDE), to be agreed upon by APL.	5.4.1.2		T				T	AXB Tube Static Load Test Report	Y	Y	16-Jun-11	SSL	
EDTRD-204	Factors of Safety for Instruments, Applied to Limit Loads	Safety factors shall be applied to account for the uncertainty of material properties in accordance with Table 5 7.	5.4.1.3.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-205	Factors of Safety for Instruments, Applied to Limit Loads	If qualified by analysis only, positive margin shall be shown for factors of safety of 2.0 on yield and 2.6 on ultimate.	Table 5-7, note 3	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	

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Req#	**Parameter/ Req Title Section**	**Requirement**	**Section**	Subassembly	Assembly	Instrument Component	Suite	Observatory	Verification Method	**Verification Description**	**FM#1**	**FM#2**	**Verification Closed/Date**	**Responsible Organization**	**Notes / Comments**
Instruments															
EDTRD-206	Factors of Safety for Instruments, Applied to Limit Loads	Factors of Safety shown for Random/Acoustics in Table 5-7 of the EDTRD shall be applied to statistically derived peak response based on RMS level. As a minimum, the peak response **shall be** calculated as a 3-sigma value.	Table 5-7, note 4	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-207	Margin of Safety for Instrument Components and Subsystems	Component strength analysis shall show all positive margins of safety (MS). With the exception of composites, glass and bonded joints, most materials require calculation of both Yield and Ultimate Margins of Safety. In general, all margins of safety **shall be** positive.	5.4.1.4.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-208	Instrument Component Stiffness	Instrument components **shall be** designed such that primary structural vibration modes shall be above 50 Hz during exposure to launch environments.	5.4.2.	A & T	A				A & T	Review of designs during PDR, CDR where design margins were presented. Tap test results of IDPU boards	Y	Y	15-Jun-11	SSL	
EDTRD-209	Instrument Component Venting Requirements	Instrument components **shall be** designed and analyzed to provide relief ports or otherwise withstand a maximum pressure rate change of 1.0 psi/sec.	5.4.3.	A	A				A	Review of designs during PDR, CDR where design margins were presented	Y	Y	15-Jun-11	SSL	
EDTRD-210	Instrument Component Venting Requirements	Pressure profile testing shall be performed unless assessment justifies deletion.	5.4.3.						N/A	Waiver Approved RBSP_EFW_CCR_008					
EDTRD-211	Instrument Component and Subsystem Shock Design and Test	Self-induced shock **shall be** considered in the design of booms, if deployable.	5.4.4.		T	T		T	T	AXB, SPB Deployments at assembly and instrument level.	Y	Y	15-Jun-11	SSL	
EDTRD-212	Instrument Component and Subsystem Shock Design and Test	Self-induced shock **shall be** tested at the observatory level by actuation of the device, allowing release of booms, protective covers, etc. This test shall be performed twice.	5.4.4.					T	T	AXB, SPB Deployments at observatory level.					
EDTRD-213	Instrument Component and Subsystem Shock Design and Test	All components that will be actuated while the spacecraft is still on the launch vehicle **shall not** exceed the limits of shock induced on the launch vehicle at the spacecraft to launch vehicle interface.	5.4.4.						N/A	N/A					
EDTRD-214	Instrument Component and Subsystem Dynamic Test Requirements	Instruments **shall be** vibrated as given in sections 5.4.5.1 and 5.4.5.2.	5.4.5.		T				T	IDPU, SPB and AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-215	Instrument Component and Subsystem Dynamic Test Requirements	During testing, all hardware **shall be** flight configured, power shall be applied (unless waiver is obtained), and selected parameters monitored.	5.4.5.						N/A	Waiver Approved RBSP_EFW_CCR_005					
EDTRD-216	Instrument Component and Subsystem Dynamic Test Requirements	Functional testing **shall be** conducted prior to and after each axis-of-vibration test to verify proper operation of the component.	5.4.5.						N/A	Waiver Approved RBSP_EFW_CCR_003					
EDTRD-217	Instrument Component and Subsystem Dynamic Test Requirements	Instrumentation **shall be** installed to identify fundamental modal frequencies of the component.	5.4.5.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-218	Instrument Component and Subsystem Dynamic Test Requirements	Prior to and after the vibration testing, a sinusoidal survey, as shown in Table 5-10, **shall be** performed for all axes to ensure no structural degradation has occurred during the protoflight testing.	5.4.5.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-219	Instrument Component and Subsystem Sine Sweep Vibration Test	Instruments shall be subjected to the following sinusoidal vibration levels in Table 5 11 and Table 5 12. These shall be applied in each of three orthogonal axes.	5.4.5.1.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-220	Instrument Component and Subsystem Sine Sweep Vibration Test	Components mounted to brackets or pedestals shall be tested with the bracket or pedestals.	5.4.5.1.							N/A					
EDTRD-221	Instrument Component and Subsystem Sine Sweep Vibration Test	Component response levels **shall be** limited so as not to exceed the maximum expected levels predicted by the LV dynamic coupling analysis. Deviations shall be reported to the Structure Engineer.	5.4.5.1.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-222	Instrument Component and Subsystem Random Vibration Test	All spacecraft components shall be subjected to the following random vibration levels in Table 5 13 and Table 5 14, which are based on GSFC-STD-7000 GEVS, April 2005. These shall be applied in each of three orthogonal axes, one of which is parallel to the thrust axis.	5.4.5.2.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-223	Instrument Component and Subsystem Random Vibration Test	Overall amplitude **shall be** kept within +1.5 dB.	5.4.5.2.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-224	Instrument Component and Subsystem Random Vibration Test	At a minimum, testing **shall** occur at the level of assembly at which the assembly is attached to the spacecraft.	5.4.5.2.		T				T	IDPU, SPB, AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-225	Instrument Component and Subsystem Random Vibration Test	If the bracket or boom mounted hardware is tested without its bracket or boom, the appropriate analysis **shall be** performed to adjust the levels to account for the change in boundary conditions. Deviations shall be reported to the JHU/APL Structure Engineer.	5.4.5.2.						N/A	N/A					

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Instruments															
EDTRD-226	EFW AXB Assembly Random Vibration Test	Therefore, the EFW AXB center cylinder assembly mounted inside the center cylinder is subject only to minimum workmanship random vibration levels and shall be tested to the levels as given in Table 5-15	5.4.5.3		T				T	AXB Vibration Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-227	Instrument Acoustic Test	Instruments that are susceptible to acoustic energy (e.g.: have thin foils, un-pinned optics) **shall** verify their capability to withstand the observatory level testing, as shown in Table 5-16.	5.4.6.						N/A	N/A					
EDTRD-228	Instrument Component and Subsystem Mechanical Interfaces	Instrument interfaces **shall be** specified in each instrument's ICD.	5.4.7.		I				I	IDPU, SPB, AXB ICD	Y	Y	15-Jun-11	SSL	
EDTRD-229	Size	Mounting hardware **shall be** accessible, as needed, for each component.	5.4.7.2.		I				I	IDPU, SPB, AXB ICD	Y	Y	15-Jun-11	SSL	
EDTRD-230	Mechancial Interface Drawings	Component mechanical interface drawings **shall be** supplied giving, as a minimum, the following: 1. Envelope drawing. 2. Center of mass location. 3. Alignment reference marks (as applicable). 4. Mounting hole location and size. 5. Fastener torque specifications and special instructions, as applicable. 6. Connector identification and location. 7. Purge location, requirements, and fitting information.	5.4.7.5.		I				I	IDPU, SPB, AXB ICD	Y	Y	15-Jun-11	SSL	
EDTRD-231	Handling	To minimize the risk of damage during handling and integration, components shall be provided with red tag covers for protecting sensitive areas, apertures, foils etc. Red tag covers **shall be** affixed to the component with captive hardware.	5.4.7.6.		I	I		I	I	AXB and SPB Red Tag Covers Delivered with Flight Hardware	Y	Y	15-Jun-11	SSL	
EDTRD-232	Instrument Component Leakage	Leakage testing **shall be** conducted to demonstrate that leakage rates of sealed hardware are within the prescribed mission limits.	5.4.8.						N/A	N/A					
EDTRD-233	Instrument Component Leakage	Leakage rates **shall be** checked before and after stress-inducing portions of the verification program to disclose anomalies caused by the stress.	5.4.8.						N/A	N/A					
EDTRD-234	Instrument Subsystem Safety Requirements	The JHU/APL Safety Engineer **shall be** made aware if any of the following items are contained in an instrument: • Deployment devices • Ionizing or non-ionizing radiation sources • High Voltage • Purge • Any Hazardous Materials • Sensitivity to Electro-Static Discharge (ESD) • Pyrotechnic Devices • Lifting Material Handling	5.8.	A	A	A		A	A	Safety Inputs Submitted	Y	Y	15-Jun-11	SSL	
EDTRD-235	Bus Characteristics at the Load Input Power Connector	The spacecraft unregulated power bus will provide power with the following characteristics to all loads. Loads shall be verified to operate within specifications for the conditions given and tested in accordance with 7417-9018 RBSP EMECP. a) Voltage Range: Critical Loads: 20-35V (S/C component test range) Non-Critical Loads: 24-35V (Instrument test range) Survival: 0-40V (40V up to 20 minutes, ground fault condition only, not to be verified by test) Critical loads as defined in Appendix A – RBSP Hardware Power Status for all Phases of the Mission shall also be tested for operation within specification at minimum voltage, all other loads shall survive minimum voltage. NOTE: The 35V covers transient conditions on the bus due to line inductance between the PSE, PDU and the Load. b) Power system internally generated ripple Voltage: 280 millivolts peak-to-peak. c) Primary power voltage transients superimposed on the DC voltage are given in 7417-9018 RBSP EMECP. d) Fuse Blowing System Response: in event of a fault requiring the Power Distribution Unit to blow a fuse, the bus voltage will temporarily drop. The magnitude and duration of the drop depends on the size of the fuse that blows. The magnitude and duration of the voltage drop expected at the	5.9.1.		T	T			T	EMC Test Report, Instrument Thermal Vacuum Report, SPB & AXB Deployment Test Reports	Y	Y	15-Jun-11	SSL	
EDTRD-236	Operating Transients and Ripple Currents	In addition to any other inrush current requirements in this document, loads shall also meet the requirements given in the RBSP EMC Control Plan and EMI Performance Requirements Specification, 7417-9018 to ensure that the fuse derating requirements are met.	5.9.3			T			T	Completed Appropriate sections of the EMECP Matrix	Y	Y	15-Jun-11	SSL	

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	EDTRD Revision Used	**Revision A**													
				Level of Assembly/Ver Method											
Req#	**Parameter/ Req Title Section**	**Requirement**	**Section**	Subassembly	Assembly	Instrument Component	Suite	Observatory	Verification Method	**Verification Description**	**FM#1**	**FM#2**	**Verification Closed/Date**	**Responsible Organization**	**Notes / Comments**
Instruments															
EDTRD-237	Operating Transients and Ripple Currents	The peak current drawn by a component load (e.g., a box) from a particular PDU load power service shall not exceed the value defined in the applicable ICD or RBSP EMC Control Plan and EMI Performance Requirements Specification, 7417-9018.	5.9.3			T			T	EMC Test Reports	Y	Y	15-Jun-11	SSL	

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ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
1	3.1.1	EFW shall comply with requirements from EMECP, 7417-9018 and EDTRD, 7417-9019 for EMC and Magnetic Compatibility. Exceptions to these requirements shall require waivers.	X		X				Completion of EDTRD an EMECP Verification Matrices	Completed EDTRD and EMECP Verification Matrices	Complete	
2	3.2.1	The spacecraft shall provide 5 separate power services to EFW. • 1 Switched power service for operational power • 2 Safety Switched power services for deployment of 2 AXB's • 2 Safety Switched power services for deployment of 4 SPB's		X						APL Integration Procedure for EFW: 9417-9773	Complete	
3	3.2.1.1	Spacecraft shall provide operational power for EFW. EFW is required to operate over a voltage range of 24-35 Vdc.	X	X		X			LVPS Test Procedure	Completed LVPS Tests Procedure	Complete	
4	3.2.1.2	Spacecraft shall provide deployment power for EFW. EFW deployment power is required to operate over a voltage range of 24 – 35 Vdc.	X	X		X			LVPS Test Procedure, Deployment Tests	Completed LVPS Test Procedure, Completed Deployment Tests	Complete	See ICD for add'l detail
5	3.2.1.3	JHU/APL shall have fusing for each EFW power service. Fuse selection for EFW is contained in Table 3-1 of ICD. ---- To ensure that load power service operating requirements are met, peak current shall not exceed the the specified peak currents in Table 3-2 of ICD.	X	X		X			Inrush Current Measurements, Instrument CPT	PDU Fuse Modules, 7417-5240 and Fuse Module Schematic, 7417-5241	Complete	
6	3.2.1.4	The load current for EFW operational power and the SPB and AXB boom deployment power shall be measured and made available in the spacecraft housekeeping telemetry.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
7	3.2.1.5	The primary input power voltage may vary between 0 (short circuit) and 40 Vdc in any sequence for an indefinite time during the RBSP observatory integration and test phase. Emergency power shutdown may occur without warning during integration and test. EFW must be capable of surviving these power events. On-orbit analyses (such as thermal analyses) do not need to show that the instrument will meet its performance specification over this voltage range.	X			X			LVPS Test Procedure	Completed LVPS Test Procedure	Complete	Requirement also listed in 7417-9019 (EDTRD)
8	3.2.2	ICD of First Circuit diagrams for Primary power and Boom Deployments contained in Fig 3-3 and 3-4.	X									
9	3.2.2.1	Spacecraft shall provide sufficient power for the power needs of EFW.		X						PDU Acceptance Test Procedure, 7417-9427	Complete	See ICD for add'l detail and characteristics of services. Related to item 5
10	3.2.2.2	EFW shall not exceed their power NTEs listed in ICD.	X			X			Instrument CPT	Completed Instrument CPTs	Complete	
11	3.2.2.3	During turn-on of the EFW power services, the EFW inrush current shall conform to requirements specified by the Electromagnetic Environment Control Plan (EMECP), 7417-9018.	X			X			Inrush Measurement	EMC Test Reports	Complete	See ICD for add'l details extracted from EMECP.
12	3.2.2.3.2	Operational or ripple currents for power services **shall** conform to that specified by the Electromagnetic Environment Control Plan (EMECP), JHU/APL Document #7417-9018.		X						PDU Acceptance Test Procedure, 7417-9427	Complete	See ICD for details extracted from EMECP

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ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
13	3.2.3.1	Circuit breaker protection located within the PDU shall remove power from EFW (with no advanced warning) if current exceeds a pre-set threshold. The circuit breaker set points selected for EFW are shown in Table 3-1.		X						Circuit Breaker Test as defined in the PDU Acceptance Test Procedure, 7417-9427	Complete	See ICD for power down sequence for removal of Operational and boom deployment services
14	3.2.3.1	Autonomy services provided by the spacecraft shall power off an EFW power service (operational, SPB boom deployment or AXB boom deployment) if power is above a pre-defined limit for a specified period of consecutive readings. Table 3-3 of ICD details the EFW fault protection actions.		X						Limits defined in RBSP Autonomy Engineering Limits Specs, 7417-9169, has been veified and is documented in RBSP Autonomy Acceptance Test Report, SIE-12-023	Complete	
15	3.2.4	ICD of EFW grounding diagram contained in Figure 3-5. Grounding and bonding requirements shall be adhered to as described in the Electromagnetic Environment Control Plan, 7417-9018 and Environmental Design and Test Requirements Document, 7417-9019.	X			X			EMC Test Report	EMC Test Reports	Complete	
16	3.3.1.1	All harnesses to spacecraft subsystems are to be provided by JHU/APL. This includes the spacecraft power, command, telemetry, spin pulse, time distribution harnesses to EFW. Backshells will be used on all spacecraft side harness connectors and all harness shall have the overall shields terminated 360°.		X						All harness were built according to 7417-8000 per RBSP fabrication Specs, 7417-9658	Complete	
17	3.3.1.2	EFW is responsible for providing any intra-instrument harnessing. This includes the harness between EFW and EMFISIS and the harness between the IDPU and the SPB/AXB deployment units.	X					X	Harness Specification	Delivered Harnesses	Complete	Details of the EFW to EMFISIS interface are contained in the EFW to EMFISIS Electrical ICD, JHU/APL Doc # 7417-9089.
18	3.3.1.3	EFW Connectors shall conform to the Electromagnetic Environment Control Plan, JHU/APL Document (7417-9018).	X		X				EFW Parts List	EFW Parts List	Complete	
19	3.3.1.4	EFW instrument connectors shall be marked with "J" numbers on the EFW instrument chassis. The mating harness and connector identification (P####) will be	X	X	X				Inspection on delivery	Delivered Harnesses	Complete	see table 3-3 for connector references.
20	3.3.1.4.1	The spacecraft power harness shall have sockets (female contacts).		X						All harness were built according to 7417-8000 per RBSP fabrication Specs, 7417-9658	Complete	
21	3.3.1.4.2	The EFW power connector shall have pins (socket contacts – MDM type connector). If an EMC gasket is required, it will be required to be on the instrument side of the interface.	X					X	LVPS Schematic	LVPS Schematic, Delivered Hardware	Complete	See tables 3-7 and 3-8 for pin definitions of power and data i/f.
22	3.4.1	The C&DH and EFW instrument shall use a standard first circuit interface for all digital electrical interfaces as shown in Figure 3-10.	X	X				X	DCB Schematic	DCB Schematic, Completed Instrument CPT	Complete	
23	3.4.1.1	The output of the differential receiver **shall** be digitally filtered or sampled so that any pulse 50 nanoseconds or less in duration is rejected.	X	X?				X	FPGA Design	FPGA Design	Complete	

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
24	3.4.2.1.2	The command data word consists of 1 start bit, 8 data bits, 1 odd parity bit, and 1 stop bit. Within the data byte the least significant data bit (bit "b0") is transmitted first. For multi-byte values, "big endian" format **shall** be used where the most significant byte is sent first. Successive data words can be sent upon completion of the previous data word.	X	X?		X			FSW CPT	FSW CPT Report	Complete	
25	3.4.2.1.3	The parity of the command data word **shall** be verified for a command data byte to be considered valid.	X			X			FSW CPT	FSW CPT Report	Complete	
26	3.4.2.2	The UART receiver **shall** properly decode command messages for which the transmitter bit length is (1/115,200) seconds +/-1.5%.	X			X			Instrument CPT	Instrument CPT	Complete	
27	3.4.3.1.2	The telemetry data word consists of 1 start bit, 8 data bits, 1 odd parity bit, and 1 stop bit. Within the data byte the least significant data bit (bit "b0") is transmitted first. For multi-byte values, "big endian" format **shall** be used where the most significant byte is sent first. Successive data words can be sent upon completion of the previous data word.	X	X?		X			FSW CPT	FSW CPT Report	Complete	
28	3.4.3.1.3	Each bit in a data word **shall** have a length of (1/115,200) seconds +/-1.5%	X			X			RBSP_EFW_TR_040	RBSP_EFW_TR_040 Baud Rate Test		
29	3.4.4	The C&DH **shall** transmit a combined 1PPS and Spin Pulse as shown in Figure 3 12. The interface uses the standard digital differential electrical interface.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
30	3.4.4.1	The 1PPS signal corresponds to the rollover of the MET seconds' timer. This **shall** be indicated on the rising edge of an 80 usec low-going pulse. A minimum of 40 usec idle period **shall** follow the 1PPS pulse.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
31	3.4.4.2	The spin pulse **shall** be indicated in the rising edge of a 40 usec low-going pulse. This **shall** be indicated in the rising edge of a 40 usec low-going pulse. A minimum of 40 usec idle period **shall** follow the spin pulse.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
32	3.4.4.3	The C&DH **shall** encode the 1PPS and spin pulse on a single data interface using an arbitration scheme that always preserves the 1PPS timing by masking the spin pulse in the 80 usec leading up to the 1PPS. Therefore, encoder introduced jitter on the spin pulse could be up to 200 usec of delay time.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
33	3.4.5	The C&DH **shall** provide a spin period timer for the purpose of generating instrument spin pulses during eclipse.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
34	3.5.1	EFW GSE shall meet the requirements within this section	X					X	BLB Schematics	BLB Schematics	Complete	
35	3.5.1.1	EFW shall provide the test connectors for each EFW box that requires GSE test connector access while installed on the spacecraft. GSE connectors for EFW will be used for hosting an enable plug, deployment simulators and load simulators (for thermal vacuum). ----- GSE-access connectors shall be different from power, signal, and data connectors.	X		X			X	SPB and AXB ICD	SPB and AXB ICD	Complete	

RBSP EFW ICD Verification

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
36	3.5.1.2	EFW GSE cabling shall meet the requirements within this section	X		X				Boom Loads Box S/C TVAC Harnesses Test	BLB Schematics / TVAC Harnesses Schematics	Complete	
37	3.5.2	The EFW IDT shall deliver connector savers for each spacecraft-instrument interface connector at the time of the EFW instruments delivery.	X		X				Inspection on delivery	Inspection on delivery	Complete	
38	3.5.3	The EFW IDT shall deliver flight-qualified, metallic, EMI-type dust cover for each connector that will not have a harness connected to it in flight.	X		X				IDPU ICD	Inspection on delivery	Complete	
39	4.1	ITFs **shall** be used to wrap CCSDS packets (the lowest level of transfer). Beyond the ITF header, only packetized data **shall** be transferred via the serial interfaces.	X	X		X			FSW CPT	FSW CPT Report	Complete	
40	4.3.1	The C&DH subsystem shall provide a separate spacecraft "on-off" command to control the power of the spacecraft-supplied EFW switched power service described in the electrical interface requirements section.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
41	4.3.2	The C&DH subsystem **shall** provide current monitoring for each of the spacecraft-supplied instrument power circuits described in the electrical interface requirements section. The data **shall** be available in spacecraft housekeeping telemetry.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
42	4.3.3	The C&DH subsystem **shall** provide temperature monitoring for each of the spacecraft provided temperature sensors as described in the thermal interface requirements section. The data **shall** be available in spacecraft housekeeping telemetry.		X						APL Integration Procedure for EFW: 9417-9773	Complete	
43	4.3.4	The C&DH subsystem will have an on-board rule-based autonomy fault protection system. This on-board system shall provide limited autonomy services which monitor the EFW power shutdown request, EFW aliveness status, and for EFW over-current conditions.		X						CDH Flight Software Requirements, 9417-9064 and CDH Flight Software Acceptance Test Spec, 7417-9493	Complete	
44	4.3.4	EFW will be responsible for their own safing and when necessary provide a flag to the C&DH subsystem (i.e. the on-board autonomy system) for external control of power or whatever safing provisions can be made by via the spacecraft.	X			X			FSW CPT	FSW CPT Report	Complete	
45	4.3.4.1	EFW shall have the capabilitiy to provide critical housekeeping data to the spacecraft autonomy system.	X			X			FSW CPT	FSW CPT Report	Complete	
46	4.3.4.2	Spacecraft autonomy shall monitor the selected power down request bit, from the ITF header, for indication of a power down request from the EFW instrument. If the EFW power down request bit is set within any received ITF header for 3 consecutive seconds, the C&DH will respond within 10 seconds to remove operational power.		X						CDH Flight Software Requirements, 9417-9064 and CDH Flight Software Acceptance Test Spec, 7417-9493	Complete	

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
47	4.3.4.3	Spacecraft autonomy will monitor the selected aliveness status bit, from the ITF header, for indication that the EFW aliveness status (heartbeat) is toggling. All EFW Power services (Operational and SPB/AXB deployment) will be removed from EFW if the C&DH detects the aliveness status has ceased to toggle in any ITF for 3 consecutive seconds and this condition persists for 16 seconds.		X						CDH Flight Software Requirements, 9417-9064 and CDH Flight Software Acceptance Test Spec, 7417-9493	Complete	
48	4.4.1.1	Spacecraft provides the ITF protocol per table 4-2		X						CDH Flight Software Requirements, 9417-9064 and CDH Flight Software Acceptance Test Spec, 7417-9493	Complete	
49	4.4.1.2	Spacecraft provides the APID range for Telecommand and Telemetry per Tables 4-3 and 4-4.	X	X		X			FSW CPT	FSW CPT Report	Complete	
50	4.4.2	The C&DH subsystem will distribute data via the spacecraft-instrument command interface using ITFs as defined in 4.4.1.1 and with the timing described in 4.4.2.2.		X						See APL Instrument Timing Test, SEG-12-015	Complete	
51	4.4.2.1	The C&DH **shall** transmit one instrument Transfer Frame (ITF) between 1 PPS pulses as shown in Figure 4 1. Each ITF includes a header and payload of at least one packet. The "Time and Status" packet, defined in Table 4 5, will be transmitted at the beginning of the ITF.		X						See APL Instrument Timing Test, SEG-12-015	Complete	
52	4.4.2.2	The spacecraft shall maintain knowledge of time and distribute time information to EFW. It is the responsibility of EFW to time-tag their telemetry packets. The spacecraft expresses time in the form of Mission Elapsed Time (MET), a 32-bit unsigned integer count that has an LSB resolution of one "MET second". The MET second is nominally equal to one UTC (Universal Time, Coordinated) second. However, it is driven by the Spacecraft's internal oscillator and will drift. MET will not be corrected on the spacecraft. A record of the drift will be maintained on the ground. The MET increments once per MET second in sync with the 1 PPS signal. It is intended to increment monotonically over the life of the mission, that is, it is intended NOT to reset. The Mission Operations Team does have the ability to "adjust" the MET but it is not planned at this time. Each spacecraft has its own oscillator and MET. Spacecraft time and status will be provided to the instruments in a single telecommand packet. The format of this packet is described in Table 4 5. Note: that all multi-byte data items are transmitted MSB first.	X	X		X			FSW CPT	FSW CPT Report	Complete	

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
53	4.4.2.3	All commands to EFW shall be in the form of CCSDS packets, including normal commands, parameter loads and software uploads. All instrument command packets shall be an even number of bytes in length. Additionally, multi-byte data items defined by the protocol are transmitted MSB first. Instruments shall define the contents and ordering of the "Data" field within the Instrument Command Message. The data layer protocol, ITF, shall be used by the spacecraft flight software when sending instrument commands to EFW (i.e. Instrument CCSDS telecommand packets will be wrapped within the command ITF). The C&DH subsystem may send zero to ten commands in a given one-second time period, the C&DH simply routes command packets to their destination as indicated by their APIDs. Contents of the packets are not processed by the C&DH subsystem.	X	X		X			FSW CPT	FSW CPT Report	Complete	
54	4.4.2.3	The C&DH subsystem **shall** provide storage for instrument time-tagged commands.		X						CDH Flight Software Requirements, 9417-9064 and CDH Flight Software Acceptance Test Spec, 7417-9493	Complete	
55	4.4.3	The C&DH subsystem shall forward all successfully received packets for storage on the recorder and/or to the real-time downlink. EFW telemetry data transfers shall be performed using ITFs as defined in Figure 4 4. EFW may produce one (1) or multiple ITFs per second. ITFs may contain complete or partial CCSDS packets. ITFs may not cross 1PPS boundaries. A timing diagram for transmitting telemetry ITFs is shown in Figure 4 4. All instrument telemetry packets (Housekeeping, Science, Space Weather, Diagnostic, etc.) shall be formatted as CCSDS telemetry packets. All instrument telemetry packets shall be an even number of bytes in length. Additionally, multi-byte data items defined by the protocol are transmitted MSB first. Instruments shall define the contents and ordering of the "Data" field within the Instrument Telemetry Message. The format of these packets is provided in Table 4 7.	X	X		X			FSW CPT	FSW CPT Report	Complete	
56	4.4.3.1	EFW provide critical housekeeping packet as shown in Table 4-8.	X			X			FSW CPT	FSW CPT Report	Complete	
57	4.4.3.2	EFW provide spaceweather data packet as shown in Table 4-9.	X			X			FSW CPT	FSW CPT Report	Complete	
58	4.4.4	The C&DH subsystem shall store EFW CCSDS telemetry packets on the solid state recorder. If EFW exceeds its recorder storage allocation, there is no guarantee the data will be downlinked. All data collected and stored within allocations, will be downlinked.	X	X		X			Mission Simulations	Mission Simulations	MSIM III	See table 4-1 for EFW allocations

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ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
59	5.2	At the mounting interface, all primary and secondary spacecraft structure required to properly position EFW shall be considered to be on the spacecraft-side of the thermal interface. --- With respect to the radiation interface, spacecraft surfaces are included on the spacecraft-side of the interface and EFW surfaces are included on the instrument-side of the interface. JHU/APL and EFW will be jointly responsible for controlling the instrument external thermal environment.		X							N/A	Information Only
60	5.2.1	Thermal control on the spacecraft-side of the EFW-to-spacecraft thermal interface (including temperatures, gradients, and rates of change, if applicable) throughout all phases of the mission is the responsibility of JHU/APL. JHU/APL shall maintain the spacecraft attitude to mission specifications. In addition, APL shall be responsible for providing information that will enable the EFW thermal engineer to select and evaluate radiator locations and blanketing schemes. --- JHU/APL is responsible for providing and mounting all thermal control hardware (i.e. heaters, thermostats, temperature sensors, thermal blankets, thermal control coatings, radiators, etc.) located on the spacecraft-side of the EFW-to-spacecraft thermal interface.		X							Thermal Balance Test Report, SEM-12-4-498, 122373 Instrument Thermal Balance & Thermal Vacuum Test Report	Complete	
61	5.2.1.2	Mounting interface temperature limits shall be no wider than -25C to +55C (maximum operating test range) during spacecraft operational modes and no wider than -30C to +60C during spacecraft survival mode. The spacecraft side of the mounting interface temperature limits shall be updated periodically by the spacecraft thermal engineer as result of revised observatory thermal analysis results, but shall be within the test predicted range as stated above. A 10C margin will be held by the RBSP spacecraft thermal engineer on each end of the test range.		X						PSR Document 05_02_PSR_Final_Williams.ppt located on Davis drive	Complete	EFW caging units ranges shown in table 5-3: -25 to +65 C (operational) -30 to +70 C (survival)
62	5.2.1.2	The EFW IDPU, four (4) SPB deploy units, AXB deploy unit, and the two (2) caging units shall be thermally coupled to the spacecraft. The EFW IDPU shall be mounted on a spacecraft provided Cho-Seal gasket. All other EFW components will be mounted to the spacecraft without Cho-Seal gasket. The interface characteristics are defined by the watt density (W/in2) at the interface.	X	X	X			X	IDPU ICD, SPB ICD, AXB ICD	IDPU ICD, SPB ICD, AXB ICD	Complete	

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
63	5.2.1.3	The EFW IDT is responsible for determining whether its design requires a specific rate of change limit and must obtain agreement from the spacecraft thermal engineer	X						Not Applicable	N/A	N/A	
64	5.2.2	Thermal control on the instrument side of the EFW-to-spacecraft thermal interface is the responsibility of the EFW IDT. Specific responsibilities include, but are not limited to: determining heater power requirements, heat rejection schemes, temperature predictions, and techniques for achieving the required isolation on the EFW side of the thermal interface, where required for all possible spacecraft attitudes. -- EFW IDT is responsible for providing and mounting all thermal isolation hardware that is affixed to EFW instrument. Any interstitial material, like thermal spacers, or additional instrument bracketing located between the spacecraft structure and the EFW shall be considered to be on the instrument-side of the thermal interface. However if thermal spacers are required as part of the installation, and are not affixed to the EFW instrument, such spacers shall be provided by EFW and installed by JHU/APL.	X				X		Thermal Analysis	Thermal Model	Complete	
65	5.2.2.1	EFW is responsible for providing telemetry for all non-spacecraft-monitored temperature sensors.	X			X			Instrument CPT	Completed Instrument CPT	Complete	
66	5.2.3	Thermal design and test of EFW shall conform to requirements within the Environmental Design and Test Requirements Document (EDTR), 7417-9019.	X			X			Instrument Thermal Vacuum	Completed Instrument Thermal Vacuum Procedure	Complete	
67	5.2.6	The AXB shall use thermostatically controlled heaters that will be powered through the AXB deployment power service to ensure the AXB are warm enough for deployment. These heaters are only used during (and shortly prior to) the AXB deployment. IDPU monitored temperature sensors will be used to verify AXB temperatures have reached adequate values prior to the actual deployment. Thermostat Set point: = ~ +20 C Heater power: = ~ 10W at 35V	X						Heaters Removed	Not Applicable	N/A	
68	5.2.9	Thermal control coatings are the responsibility of EFW IDT. ----- The IDPU is the only EFW component that requires a high emissivity surface coating (e.g. Aeroglaze Z307 black paint or BR127NC black primer).	X		X			X	IDPU ICD	IDPU ICD & Delivered Hardware	Complete	

RBSP EFW ICD Verification

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
69	5.2.10	The EFW to observatory MLI blanket interface is the joint responsibility of the EFW IDT and JHU/APL. Design details will be developed cooperatively. Blanket interfaces are captured in Figures 5-1 thru 5-3 for the SPB, AXB and Caging Mechanism to spacecraft interfaces. • External blanket surface electrical resistivity shall be <= 10^5 ohms/square (see RBSP EMC Spec) • The size of all non-conductive areas shall be reported to the JHU/APL system engineer. Approval of non-conductive areas shall require approval of JHU/APL in view of electrostatic requirements. .	X	X	X				APL Provided Blankets	APL Provided Blanket Designs	Fit Check of Blankets after delivery needed	
70	6.2	JHU/APL is responsible for providing standard mounting hardware. The EFW IDT shall supply any non-standard or unique mounting hardware.	X	X					No non-standard mounting hardware used	Not Applicable	N/A	
71	6.2.1	JHU/APL is responsible for providing the mounting surface(s) for the payload instrument.		X						APL Integration Procedure for EFW, 9417-9773 and Mechanical Installation Procedure, 7417-9409	Complete	Per EFW provided MICDs
72	6.2.2	EFW shall be designed and tested to the requirements in the RBSP Environmental Design and Test Specification, (EDTR), 7417-9019. Any exceptions to these requirements shall require waiver submittal.	X		X				Waivers, EDTRD Matrix	Waivers, EDTRD Matrix	Complete	
73	6.2.2	EFW shall supply applicable mechanical interface drawing information necessary for both EFW and the spacecraft to proceed with design to be included within this ICD.	X		X				IDPU ICD, AXB ICD, SPB ICD	IDPU ICD, AXB ICD, SPB ICD	Complete	
74	6.2.4	The spacecraft will provide a planar mounting surface to which the payload instrument components are attached. For mounting of the EFW instrument, the bracket surface will be flat to less than 0.010 inches per foot (0.254 mm per 304.8mm), and to less than 0.030 inches (0.762 mm) across the entire mounting surface. ------ The spacecraft mounting surface shall be free of paint.		X						Mechanical Installation Procedure, 7417-9409	Complete	
75	6.2.5	EFW shall provide a planar surface for mounting to the spacecraft. The EFW mounting surfaces will be flat to less than 0.010 inches per foot (0.254 mm), across the longest span of the component with flatness to less than 0.002 inches per square inch (0.0508mm per 25.4 x 25.4 mm square). The average surface roughness height rating shall not exceed 125 micro-inches (3.175 micrometers) along any instrument's longest dimension. The instrument mounting surface shall be free of paint.	X			X			IDPU ICD, AXB ICD, SPB ICD	IDPU ICD, AXB ICD, SPB ICD	Complete	

RBSP EFW ICD Verification

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
76	6.3.1	JHU/APL shall provide the necessary clearance for EFW SPB and AXB dynamic envelopes.		X						APL Integration Procedure for EFW, 9417-9773 and Mechanical Installation Procedure, 7417-9409	Complete	
77	6.3.9	The RBSP spacecraft shall be able to structurally accommodate the stowed instruments based on its "not-to-exceed" mass allocations summarized in this section.		X						Mass measurements were verified in Mechanical Installation Procedure, 7417-9409	Complete	
78	6.3.10	EFW shall not exceed the mass allocation shown in Table 6.2. The as-delivered measured mass shall be provided to an accuracy of 0.01 kg. When the EFW IDT reports its mass estimates, each assembly shall be measured to within ± 0.05 kg.	X			X			Mass Properties Measurements	Mass Properties Measurements	Complete	
79	6.3.11	EFW shall provide estimated location of CG at time of the observatory PDR and CDR milestone. The final measured value shall be located within ± 0.10 (inch of the estimated location. --- The center of mass shall be defined relative to the EFW interface reference frame as defined by the Mechanical Interface Drawings in Appendix A.	X			X			Mass Properties Measurements	Mass Properties Measurements	Complete	
80	6.3.12	The rigid body moments of inertia of EFW shall be provided by means of calculation at time of the observatory PDR and CDR milestone. The instrument subsystem moments of inertia shall be defined about the center of mass for each EFW subsystem in its respective stowed flight and deployed mission configuration. The subsystem moments of inertia will be estimated about coordinate system axes that are parallel to the RBSP observatory coordinate frame. ---- Products of inertia shall be defined by a "+" sign convention. Rigid body moments and products of inertia for each EFW subsystem in its stowed flight and deployed mission configuration as well as the dynamic body moments and products of inertia for each EFW subsystem in its deployed mission configuration are captured in the provided MICD drawings in Appendix A.	X			X			Mass Properties Measurements	Mass Properties Measurements	Complete	
81	6.4.1.3	JHU/APL shall provide mounting points for designated EFW ground strap(s). Hardware for mounting EFW instrument ground straps shall be provided by JHU/APL. The ground point interface on the spacecraft is a #8-32 rivnut.		X						APL Integration Procedure for EFW, 9417-9773 and Mechanical Installation Procedure, 7417-9409	Complete	
82	6.4.2.1	EFW is responsible for the intra-instrument harnessing between the IDPU and SPB and AXB deployment units.	X					X	RBSP__EFW_SYS_015E	Delivered Harnesses	Complete	
83	6.4.2.2	JHU/APL shall supply ground straps for EFW if needed. Ground straps will be added under a mounting bolt on the components.		X						APL Integration Procedure for EFW, 9417-9773 and Mechanical Installation Procedure, 7417-9409	Complete	

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ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
84	6.4.2.3	Protective plugs (flight and non-flight) associated with EFW shall be documented by EFW IDT, approved by JHU/APL and will be documented in the ICD.	X		X				Deployment Enable Plugs	Incoming Inspection	Complete	Deploy protection Plugs used for AXB and SPB -
85	6.4.2.5	EFW IDT shall provide any special mounting fixtures used for mounting their instruments to the spacecraft.	X		X				AXB Lifting Fixture	AXB Lifting Fixture	Complete	
86	6.5.1	JHU/APL shall be responsible for mounting the instrument assemblies to the spacecraft. JHU/APL will provide threaded inserts in the correct positions to mount EFW. The EFW IDT will provide written procedures to address special mounting concerns for the instrument assemblies. UCB CogE or approved representative will be present during any installation or removal of EFW instruments, covers, or	X	X	X				UCB CogE Present for Installations	UCB CogE Present for Installations	Complete	
87	6.5.3	EFW IDT will have identification markings on the instrument. The markings shall be permanent, resistant to chipping and located such that the markings are visible when the instrument is integrated to the spacecraft.	X		X				IDPU ICD, AXB ICD, SPB ICD	Incoming Inspection	Complete	
88	6.5.4	The EFW SPB deployment tests will be conducted during EME compatibility test. This will be a partial 'walk out' deploy of the SPBs only. The AXB whip first motion testing will be performed during Observatory level environmental testing. This testing will require the observatory to be placed in the horizontal position. There will be no other deployment test performed during spacecraft I&T. EFW will supply load simulators at the enable/test connectors on each boom unit so that simulated deployments can be performed. ---- For any deployment testing, EFW shall define spacecraft configuration and orientation requirements. An initial deployment test plan shall be produced (ref document RBSP_EFW_TE_001) by spacecraft PDR and updated by spacecraft CDR.	X			X			Deployment Tests on S/C	Deployment Test on S/C Reports		
89	7.3	EFW shall comply with the requirements for contamination contained in the RBSP Contamination Control Plan (CCP), 7417-9011.	X			X	X		SSL Contamination Plan	Incoming Inspection	Complete	
90	7.3.1	Materials that exceed TML and CVCM values **shall** be brought to the attention of the RBSP Contamination Engineer and will require a waiver submittal for approval.	X			X	X		Contamination Plan	Materials List	Complete	
91	7.3.2	EFW shall meet the minimum cleanliness levels of VC2 (note: VC2 is equivalent of Visually Clean High Sensitive (VCHS)). VC2…is defined as the absence of all particulate and non-particulate matter visible to the normal unaided eye with indident light level of greater or equal to 100 foot-candles from a distance of 6 to 18 inches.	X			X	X		Contamination Plan	Incoming Inspection	Complete	

RBSP EFW ICD Verification

ID	ICD Ref.	Object Text	EFW	SC	Method				Activity/Plan	V-Product	Status	Comment
					I	T	A	D				
92	7.4	EFW shall comply with the requirements for magnetic and electrostatic control as contained in the EMECP and the EDTRD/	X		X				Completed EDTRD and EMECP Matrices	Completed EDTRD and EMECP Matrices	Complete	
93	7.4.1	Use of magnetized tools shall not be used at any time. In order to assure that the EFW and spacecraft are not magnetically contaminated, all tools shall be degaussed prior to use on any part of the observatories.	X	X	X	X	X	X	Follow APL Magnetics Guidelines	Follow APL Magnetics Guidelines	Complete	
94	7.5.2	Restrictions as stated in paragraph **shall** apply to electrical GSE	X		X				Incoming Inspection of GSE	Incoming Inspection of GSE	Complete	

RBSP EFW EMECP Verification															
V1.0		21-Aug-09													
	Verification Matrix for the Electromagnetic Environment Control Plan (EMECP, 7417-9018, Rev A)														
				Level of Assembly/Ver Metho						Completion Date					
Req #	Parameter/ Req Title Section	Requirement	Document	Subassembly	Assembly	Instrument Component	Suite	Observatory	Verification Description A = Analysis T = Test I = Inspection D = Demonstration	FM#1	FM#2	Results (Pass/Fail)	Responsible Organization	Notes / Comments
1.	**3.2.1. Deep Dielectric Charging (DDC) Mitigation**	3.2.1.1. Design Requirements												
1.1		All devices containing active electronic part shall be shielded to an equivalent of 350 mils of Aluminum. Any device unable to meet this requirement can present analysis showing the device will operate in the charging environment with no problems to the EME Working Group for approval by the EME Engineer. This includes identifying the use of dielectrics that do not fall below the safe curve in figure 3.1.1.-3. The magnetic and electric field boom sensors are expected to fall in this category.	EMECP 3.2.1.1		x				I	Y	Y	P	SSL	IDPU ICD
1.2		The propulsion diode boxes, TRIOs, and VRIOs shall have at least 160 mil shielding, the Solar Array is exempted and release mechanisms are exempted because their use is over before charging can build up.	EMECP 3.2.1.1		x				I	N/A	N/A	N/A	N/A	
1.3		All interfaces with harnesses external to the box shall be designed to survive the multiple discharges from the harness materials using the model shown in figure 3.1.1.-2a. Use low pass filters and/or transient protection on all interface circuits. Parts rated to survive ESD discharge up to 2500 V before derating should be used for the interface circuits. Document 7417-9120 "RBSP Spacecraft Electrical Interface Control Document" and device specifiec ICDs contain specific first circuit requirements. It should be noted that lines adjacent to a discharge can experience up to 10% of the discharge voltage due to close coupling.	EMECP 3.2.1.1		x				I	Y	Y	P	SSL	DDD Tests Reports of interface components
1.4		All cables and/or test equipment shall be discharged prior to connection to any flight or spare hardware.	EMECP 3.2.1.1		x				D	Y	Y	P	SSL	SSL ESD Plan
1.5		Every connector shall be covered with an ESD cover when not in use.	EMECP 3.2.1.1		x				D	Y	Y	P	SSL	SSL ESD Plan
1.6		All unused flight connectors shall be covered with an RF tight metallic ESD cover for flight.	EMECP 3.2.1.1		x				D	Y	Y	P	SSL	IDPU ICD
2.	**3.2.2. Surface Charging Mitigation**	3.2.2.1. Design Requirements												
2.1		All external surfaces shall be conductive with surface resistivity under 10^5 ohms per square. This includes the exterior and interior surface of the spacecraft, the exterior surface of devices, radiators, heaters, tape, thermal blankets, etc. Current exceptions are solar array grout and kapton isolation, solar panel back substrate, and DSAD cover plate. Black anodize fails this requirement so black conductive paint should be used if black is necessary.	EMECP 3.2.2.1		x				I	Y	Y	P	SSL	IDPU, AXB, SPB ICD

RBSP EFW EMECP Verification															
V1.0		21-Aug-09													
	Verification Matrix for the Electromagnetic Environment Control Plan (EMECP, 7417-9018, Rev A)														
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2.2		Any material not meeting this requirement shall be brought to the attention of the EME Engineer for evaluation and included on the Charging Watch List.			x				D	Y	Y	P	SSL	
2.3		All external surfaces shall be grounded together.	EMECP 3.2.2.1		x				I	Y	Y	P	SSL	EMC Test Report
2.4		a. MLI Blankets shall have less than 10 ohms from blanket ground pad to local chassis			x				I	Y	Y	P	APL	APL has verified this requirement during integration, when MLI blankets were installed in individual WOT. Verification is required for all future WOT that involves MLI Blankets.
2.5		b. Devices shall have less than 5 milliohms from box to local chassis			x				I	Y	Y	P	SSL	EMC Test Report; APL has verified this requirement during integration per integration procedure 9417-9773
2.6		c. Adjacent metal surfaces shall have less than 2.5 milliohms between the two surfaces			x				I	Y	Y	P	SSL	EMC Test Report; APL has verified this requirement during integration per integration procedure 9417-9773
2.7		d. External Shields on harnesses shall have less than 20 milliohms resistance between the shield on the harness and the device attached to. This requirement will be met if the shield to harness connector resistance is less than 10 milliohms.			x				I	Y	Y	P	SSL	EMC Test Report; APL has verified this requirement during integration per integration procedure 9417-9773
2.8		All MLI Blankets shall use metalized conductive black kapton with the appropriate conductive thermal coat for the location.	EMECP 3.2.2.1		x				I	Y	Y	P	APL	The MLI blankets provided by APL were built per 7417-1312
2.9		ITO coated silver Teflon shall not be used since it does not survive the RBSP radiation environment.			x				D	N/A	N/A	N/A	N/A	N/A
2.10		All MLI Blankets shall have all conductive (i.e., metalized) layers electrically bonded together at every ground pad	EMECP 3.2.2.1		x				I	Y	Y	P	APL	The MLI blankets provided by APL were built per 7417-1312
2.11		All MLI Blankets larger than 50 cm perimeter shall have 2 ground pads with an extra ground pad for each .25 m^2 area.	EMECP 3.2.2.1		x				I	Y	Y	P	APL	The MLI blankets provided by APL were built per 7417-1312
2.12		Blankets with perimeter less than 50 cm shall be grounded to another blanket or local chassis with less than 1000 ohms.			x				I	Y	Y	P	APL	APL has verified this requirement during integration, when MLI blankets were installed in individual WOT. Verification is required for all future WOT that involves MLI Blankets.
2.13		All MLI Blankets shall have less than 10 ohms resistance between adjacent ground pads prior to connection to the spacecraft	EMECP 3.2.2.1		x				I	Y	Y	P	APL	APL has verified this requirement during integration, when MLI blankets were installed in individual WOT. Verification is required for all future WOT that involves MLI Blankets.

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2.14		The primary grounding path for electrical devices not thermally isolated shall be by metal to metal contact between the bottom of the component and the next level of attachment, with a Cho-Seal pad if needed for thermal properties.	EMECP 3.2.2.1		x				I	Y	Y	P	APL	APL Supplied; APL installed per RBSP Mechanical Component Installation Procedure, 7417-9409
2.15		Any electrical device that requires thermal isolation from the spacecraft shall have at least 2 widely separated ground lugs for attachment of ground straps. Every increment of 0.25 m^2 foot print area requires an additional ground lug and strap.	EMECP 3.2.2.1		x				I	Y	Y	P	APL	APL installed per RBSP Mechanical Component Installation Procedure, 7417-9409, with appropriate ground straps, 7417-1320
2.16		All ground straps shall have a length less than 5 times the effective width of the strap. A flattened tubular braid has an effective width of twice the width due to the top and bottom braids.	EMECP 3.2.2.1		x				I	Y	Y	P	APL	APL installed per RBSP Mechanical Component Installation Procedure, 7417-9409, with appropriate ground straps, 7417-1320
		Ground frame around the panel which shall meet 10^8 ohms per square 2. Solar cells covered with ITO 3. Cell to cell interconnects are covered with non-conductive adhesive (eg RTV) 4. String end terminations covered with non-conductive adhesive (eg RTV) 5. ITO coated coverglass are all electrically connected by wire (conductive adhesive bonds wire to ITO) and tied to ground. 6. Grounded facesheet on back of array which shall meet 108 ohms per square 7. Back panel wires are shielded, shields bonded to conductive back with conductive adhesive	EMECP 3.2.2.1		x				I	N/A	N/A	N/A	N/A	
3.	**3.2.3. Design Requirements for Magnetic Mitigation**	3.2.3.1. Design Requirements												
		Though the magnetics program for RBSP is informal, due to the nature of some of the components and processes it is necessary to levy requirements. The mission requirements require dynamic magnetic fields generated by all spacecraft components to be <0.1 nT total and static fields to be less than 5.0 nT total at the MAG sensor. The dynamic requirement is for any change in magnetic field that happens over a time period of 0.1 seconds to 2 weeks.			x				A	Y	Y	P	APL	DC Magnetics Incoming Survey
		Longer times fall under the static requirement and shorter times are covered by the requirements for the Search Coils which are covered by the MIL-STD-461C RE-01 requirement in section 4. Of particular concern is the use of Low Voltage parts that pull substantial repetitive currents. These circuits will turn on for a while drawing large currents with possible high frequency modulation then turn off. This on – off cycle creates low frequency magnetic fields which could disrupt science measurements. These circuits feed and return lines, must be carefully laid out to minimize the area inside the closed current loop from the power supply to the part and back as required in line 5 below.			x				A	Y	Y	P	SSL	EMC Test Report

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3.1		When deployed, the base of the magnetometer shall be no less than three (3) meters away from the nearest edge of the main body of the Observatory. The distance enables RBSP's informal magnetics program.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	
3.2		When deployed, the base of the Search Coil shall be no less than three (3) meters away from the nearest edge of the main body of the Observatory. The distance enables RBSP's informal magnetics program.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	
3.3		The solar array shall be back-wired to minimize the magnetic moments. This requirement shall be flowed down to the solar array manufacturer.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	
3.4		A single point isolated ground system shall be used for the main power as shown in Fig 3.1.4-1	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.5		All signals inside devices shall have a return which shall be routed as close as possible to the signal to minimize loop area. This is particularly important for the new low voltage chips that pull substantial currents repetitively. Either a power plane should be used to distribute current with a ground plane for the return current, or matching traces should be used to feed and return the current. A trace over a ground plane should not be used for any changing current over TBD milliamps or static current over TBD amps.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.6		All signals shall be in the same connector with their return.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.7		All signals in wires shall be twisted with their respective return lines or be in impedance controlled lines.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.8		Twisted pair or quad shall be used for all power lines.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.9		Grounding shall be designed to avoid ground loops.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
3.10		Metal nutation dampers shall be made of space grade Titanium tubing and shall be grounded to the spacecraft deck with less than 1000 ohms resistance.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	
3.11		The use of bulk magnetic materials including non-magnetic stainless steel, shall be identified to the EMEWG, for review and approval. Stainless Steel of cold work permeability less than or equal to grade 305 is allowed without identification. This includes grades 305, 308, 310, 316 and A286.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	Materials & Parts Lists
3.12		All Mag and Search Coil boom materials and hinges shall be non-magnetic.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	

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3.13		As part of qualification testing all subsystems shall undergo a sniff test to map the magnetic emissions. Conducted emissions and magnetic sniffing should be started at the earliest part of development as possible and checked repeatedly as the device develops. Since the hardest requirements to meet are below 15 kHz, a simple multi-turn coil attached to an oscilloscope can be used to check for magnetic emissions.	EMECP 3.2.3.1		x				T	Y	Y	P	APL	DC Magnetics Incoming Survey Sniff test performed per integration procedure, 9417-9773
3.14		Non-magnetic connectors shall be used for all components.	EMECP 3.2.3.1		x				I	Y	Y	P	SSL	EFW Parts List
	Specific actions that are necessary during Observatory (I&T)													
3.15		Magnetically attached tools shall not be used at any time.	EMECP 3.2.3.1		x				D	N/A	N/A	N/A	APL	RBSP Hardware Magnetic Cleanliness Verification Procedure, 7417-9822; Magnetics training for all cleanroom personnel
3.16		Tools and Fasteners shall be degaussed prior to entry into the clean room.	EMECP 3.2.3.1		x				D	N/A	N/A	N/A	APL	RBSP Hardware Magnetic Cleanliness Verification Procedure, 7417-9822; Magnetics training for all cleanroom personnel
3.17		The use of motor devices near the Observatory shall require the approval of the EME Engineer, the I&T lead, or the EMFISIS on-site representative.	EMECP 3.2.3.1		x				D	N/A	N/A	N/A	N/A	
3.18		Load cells shall be kept well away from the spacecraft because they have permanent magnets. The exact limitation will be addressed in the spacecraft lift and handling procedures.	EMECP 3.2.3.1		x				D	N/A	N/A	N/A	N/A	
3.19		The vibration table shall be “magnetically compensated” prior to testing of the Observatory. This is a standard procedure that can be run when magnetically sensitive instruments are tested.	EMECP 3.2.3.1		x				I	N/A	N/A	N/A	N/A	
3.20		Each Observatory shall undergo a Swing Test. As a fully integrated configuration, each Observatory will be swung from a crane over an angle of less than 10 degrees. The Magnetometer Team will set up GSE magnetometers to characterize the magnetic moments of each Observatory. Solar arrays and MAG and Search Coil booms need not be present during this test.	EMECP 3.2.3.1		x				T	N/A	N/A	N/A	N/A	
3.21		The use of magnetic materials should be minimized and any use of such materials, including nonmagnetic stainless steel, shall be identified to the EMEWG, for review and approval. This does not imply detailed part oversight.	EMECP 3.2.3.2		x				D	N/A	N/A	N/A	N/A	

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4.	**3.2.4. Design Requirements for Electromagnetic Compatibility**	3.2.4.1. Design Requirements												
4.1		3.2.4.1.1. Each Spacecraft shall be securely connected to local facility ground at all times unless conducting an all plugs out test. This requires two ground leads be attached to each spacecraft for every move so one can be walked forward while the second is still attached.	EMECP 3.2.4.1		x				D	N/A	N/A	N/A	N/A	
4.2		3.2.4.1.2. Spacecraft-to-spacecraft and spacecraft-to-vehicle interfaces shall be clean and conductive to provide a mating bond resistance not exceeding 2.5 milliohms	EMECP 3.2.4.1		x				D	N/A	N/A	N/A	N/A	
4.3		3.2.4.1.3. Spacecraft Structure bond resistance shall be maintained at 10 milliohms or less between any panel and the 9 other panels and the central cylinder.	EMECP 3.2.4.1		x				D	N/A	N/A	N/A	N/A	
4.4		3.2.4.1.4. Doors and other hinged or shafted devices shall have a ground strap, wire, or conductive spring across the hinge or shaft to provide a reliable bond resistance not exceeding one hundred ohms to assure a drain path for electrostatic charge	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	EMC Test Report
4.5		3.2.4.1.5. All electronic circuitry, including terminal boards, batteries, heaters, thermal sensors, etc., shall be enclosed in a metallic RF grounded shield, sufficient to meet the radiated emission and susceptibility requirements. If practicable, the separation switches should also be enclosed in an appropriate shield. Exceptions: solar panel faces (sun side), antennas, and DSAD optical apertures, of necessity, will not be shielded	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	EMC Test Report
4.6		3.2.4.1.6. Overall shields with 360 degree termination at all connectors shall be implemented on **all** harness. Document 7417-9658, "RBSP Harness Fabrication Instruction" contains detailed harness construction specifications.	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	Harness Specification Document / Incoming Inspection
4.7		3.2.4.1.7. Overall cable shields, other than coaxial cables, shall never be used as intentional return paths for either signal or power circuits. Every effort should be made to minimize the flow of any currents in outer shields since these currents will a) be coupled, through the cable's transfer impedance, as interference to the circuits enclosed by the shield, b) be responsible for common impedance coupling to other circuits, or c) be converted to radiated emissions	EMECP 3.2.4.1		x				I & D	Y	Y	P	SSL	Harness Specification Document
4.8		3.2.4.1.8. Cables containing one or more internal shields shall have these internal shields DC terminated to chassis at both ends unless the line is a communications circuit.	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	Harness Specification Document
4.9		Then the internal shield shall be terminated to chassis at the transmitter end only.			x				I	Y	Y	P	SSL	EFW ICD
4.10		Internal shields shall be stripped back no more than 3 cm			x				I	Y	Y	P	SSL	Harness Specification Document

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		and shall be terminated with no more than 10 cm of wire.			x				I	Y	Y	P	SSL	Harness Specification Document
4.11		3.2.4.1.9. The umbilical pull-away connector shall have all umbilical lines properly terminated to prevent wire charging and be designed to survive the dielectric discharge of the wire insulation.	EMECP 3.2.4.1		x				I	N/A	N/A	N/A	N/A	
4.12		3.2.4.1.10. RF and ESD safe shipping containers shall be used for all flight electronics	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	Shipping Boxes
		and shall be opened and closed by ESD grounded personnel			x				D	Y	Y	P	APL	RBSP Hardware Magnetic Cleanliness Verification Procedure, 7417-9822; Magnetics training for all cleanroom personnel
4.13		3.2.4.1.11. Venting holes needed in a device or the spacecraft that are larger than 3 mm diameter shall be covered with conductive screening with mesh size no more than 1.0 mm square.			x				I	Y	Y	P	SSL	IDPU ICD
4.14		The screening shall be bonded on all sides with less than 2.5 milliohms resistance. Be careful that vent holes do not reduce the required 350 mil shielding and expose internal electronics to the space plasma. Drilling a vent hole at an angle through one surface aimed at an adjacent surface meets the requirement.	EMECP 3.2.4.1		x				I,T	Y	Y	P	SSL	IDPU ICD
4.15		3.2.4.1.12. Box closure seam aperture length shall not exceed 6.0 cm (e.g., cover screw spacing) or lapped seams must be used. Closer spacing of fasteners to 2.5 cm is encouraged	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	IDPU ICD
4.16		3.2.4.1.13. Woven harness shields on cables outside boxes shall provide at least 80 percent optical coverage, or at least 50 percent optical coverage with a 100 percent optical coverage Metal foil underlayment	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	Harness Specification Document
4.17		3.2.4.1.14. Signal cables shall be bundled and shielded separate from and, where practicable, routed separate from primary power and heater cables to minimize noise coupling from the primary power bus	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	Harness Specification Document
4.18		3.2.4.1.15. Wrapped harness shields on cables outside boxes shall provide at least 50 percent over-wrap throughout	EMECP 3.2.4.1		x				I,D	Y	Y	P	SSL	Harness Specification Document
4.19		3.2.4.1.16. Appropriate ESD safeguards shall be followed at all levels of electronic assembly, inspection, test, transport, and storage	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	SSL ESD Plan
4.20		3.2.4.1.17. All cables, including coax, that are not known to be adequately discharged, shall have all conductors discharged through an appropriate resistance (between 5000 ohms and 2 megohms to prevent micro-weldments at plated pins) to safe levels prior to connection to any interface. This also includes solar panels	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	SSL ESD Plan
4.21		3.2.4.1.18. Ordnance firing, control, and monitor circuits shall all be shielded from each other	EMECP 3.2.4.1		x				I	N/A	N/A	N/A	N/A	
4.22		3.2.4.1.19. Ordnance connector design shall ensure that the shielding connection is complete before the pin connections	EMECP 3.2.4.1		x				I	N/A	N/A	N/A	N/A	

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4.23		3.2.4.1.20. Primary power input lines (30 VDC nominal), and all heater circuits, shall be electrically isolated within each Subsystem by at least one megohm 1) from each other (unless internally switched or controlled), 2) from chassis ground, and 3) from all secondary circuits	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	EMC Test Report
4.24		3.2.4.1.21. Components bridging the primary power isolation interface (capacitors, transformers, board traces, heat sinks, etc.) shall be sized to withstand a potential difference of 100 VDC minimum prior to derating.	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	LVPS Schematic
4.25		3.2.4.1.22. Primary power shall be supplied to each Subsystem, and subsequently to each internal power converter or heater, through one or more separate, dedicated connectors through which there are to be no signal, control, or other secondary lines	EMECP 3.2.4.1		x				I	Y	Y	P	APL/SSL	EFW ICD, 7417-9083
4.26		3.2.4.1.23. All primary power input lines shall self-discharge to less than 5 VDC within 5 seconds after power removal	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	EMC Test Report
4.27		3.2.4.1.24. DC/DC converter frequencies shall be either above 400 kHz or an integer multiple of 50 +/- 1% kHz over all temperature and life. Units not meeting this requirement must present their grounding, wiring, power and frequency characteristics for waiver approval.	EMECP 3.2.4.1		x				A	Y	Y	P	SSL	LVPS Schematic
4.28		3.2.4.1.25. Components shall be capable of surviving any primary power input voltage between zero (short circuit) and 40 V DC, applied in any sequence, for an indefinite time. The application of 40V is a non-flight scenario and is likely to be less than 20 minutes in duration. This duration is given as a reasonable test case to show compliance with the requirement. Compliance with the 40 V requirement can also be shown by analysis	EMECP 3.2.4.1		x				A orT	Y	Y	P	SSL	LVPS Test Report
4.29		3.2.4.1.26. Components shall be capable of surviving the application of a hard short circuit across the primary power input lines (possible reverse input current).	EMECP 3.2.4.1		x				A or T	Y	Y	P	SSL	LVPS Test Report
4.30		Components shall prove that the stored charge of their hardware (i.e., the outrush current) will not blow fuses in the event of a hard short on the power bus by test or analysis.			x				A orT	Y	Y	P	SSL	LVPS Test Report
4.31		3.2.4.1.27. Secondary circuit returns shall be connected internally to chassis ground (except for power converters located remotely as described below)	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	EFW Grounding Diagram
4.32		3.2.4.1.28. Power converters located remotely (i.e., in a separate box) from their load circuitry shall have the secondary power return referenced to chassis only at the load, not at the converter.	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	LVPS Schematic
4.33		Remotely located converters powering multiple units (i.e., separate boxes) shall have individual, isolated output windings for each load unit. EFW sensors, Battery pressure sensor circuits and RIUs are exempt because they float all electronics at the load so the reference can be at the source.			x				I	N/A	N/A	N/A	N/A	

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4.34		3.2.4.1.29. To protect Spacecraft harness and electronics, all GSE or test cables, including coaxial cables, that might at any time be connected to hardware integrated with the Spacecraft shall provide effective electrical isolation (i.e., to facility ground and power) of at least 1000 ohms in parallel with a maximum capacitance of 2 nanofarads and withstand a voltage difference of at least 500 volts peak-to-peak. Exception: Spacecraft-to-ground safety connection, Solar Array Simulator, and Battery Charger	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	BLB Schematics
4.35		3.2.4.1.30. Signal interfaces between the Spacecraft and any test GSE shall be protected against damage, stress, or inappropriate response resulting from either the application or removal of power from circuits at either side of the interface	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	BLB Schematics
4.36		3.2.4.1.31. All battery powered GSE leads shall be grounded out to spacecraft structure before attaching to any spacecraft measurement point	EMECP 3.2.4.1						D	N/A	N/A	N/A	N/A	
4.37		3.2.4.1.32. All AC powered GSE shall have a separate ground strap or ground wire bolted to the GSE's metal chassis or rack which connects it to the facility ground bus that is shared with the Spacecraft facility ground connection	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	GSE Incoming Inspection at APL
4.38		3.2.4.1.33. Each individual item within the GSE, unless battery powered, shall have an AC power cord incorporating a safety ground wire in accordance with NEC and local code requirements and also have an appropriate internal fuse or circuit breaker	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	GSE Incoming Inspection at APL
4.39		3.2.4.1.34. GSE AC power interfaces shall incorporate internal EMI filters and line transient spike suppressors (e.g., an Isobar)	EMECP 3.2.4.1		x				I	Y	Y	P	SSL	GSE Incoming Inspection at APL
4.40		3.2.4.1.35. Other than the Solar Array Simulator and Battery Charger, no GSE shall supply power to any circuit attached to the spacecraft without prior permission from the Integration & Test Engineer	EMECP 3.2.4.1		x				D	Y	Y	P	SSL	GSE Incoming Inspection at APL
4.41		3.2.4.1.36. Prior to any lifting operations, the Spacecraft-to-lifthook potential difference shall be determined to be less than 0.3 Volts DC and less than 0.5 Volts rms AC while the lift motor is 1) unpowered and 2) while operating (powered)	EMECP 3.2.4.1		x				I	N/A	N/A	N/A	N/A	
5.	**4. SUBSYSTEM EMI TEST REQUIREMENTS**													
5.1		Specific test configurations for each test are described in this document and are intended to supplement test methods described in MIL–STD–462. Expected deviations from these methods or procedures shall be presented to the EME Engineer for approval prior to testing.	EMECP 4.			x			T	Y	Y	P	SSL	EMC Test Report
5.2		Any deviations required during testing shall be fully documented, described and photographed (preferably digital) in the test report.	EMECP 4.			x			D	Y	Y	P	SSL	EMC Test Report

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5.3	**4.1. CE-01 CONDUCTED EMISSIONS, 10 HZ TO 15 KHZ**	This test requirement is to demonstrate that the levels of low frequency conducted current emissions on input power and interface signal lines do not exceed the specified limits. The specified limits start at 50 Hz but measurements shall continue down to 10 Hz for information only. Be careful of 60 Hz and harmonic noise from the GSE coupling into the test system.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.4		A) Differential currents are to be measured on the following lines: 1. Power input (single leg measurement) 2. Power input return (single leg measurement) 3. True differential current on power, only if 1 or 2 exceeds specification limit. This measurement is acquired by passing the return line outside the probe and looping it back inside the probe to cancel the common mode current, and then dividing the measured current by two.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.5		B) Common mode currents are to be measured on the following lines: 1. Power input with return including heater circuits. 2. All other interface lines collectively at each connector (except RF).	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.6		C) Narrowband measurements are to be made with an effective bandwidth not exceeding 120 Hz.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.7		D) No CE-01 broadband measurements are required.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.8		E) Differential mode test limits are 80 dBµA (10 mA rms) from 50 Hz to 10 kHz then decreasing to 70 dBuA at 15 kHz.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.9		F) Common mode test limits are 60 dBµA (1.0 mA rms) from 50 Hz to 10 kHz then decreasing to 50 dBuA at 15 kHz.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.10		G) Refer to Figure 4.1&2.	EMECP 4.1			x			T	Y	Y	P	SSL	EMC Test Report
5.11	**4.2. CE-03 CONDUCTED EMISSIONS, 15 KHZ TO 50 MHZ**	This test requirement is to demonstrate that the levels of high frequency conducted current emissions on input power and interface signal lines do not exceed the specified limits. The specified limits stop at 1 MHz but measurements shall continue up to 50 MHz for information only.	EMECP 4.2			x			T	Y	Y	P	SSL	EMC Test Report
5.12		A) Interface lines to be measured are the same as previously described for CE-01 for both differential and common mode measurements.	EMECP 4.2			x			T	Y	Y	P	SSL	EMC Test Report
5.13		B) Differential mode narrowband test limits are 70 dBµA (~3.1 mA rms) from 15 kHz decreasing to 60 dBµA (1 mA rms) at 400 kHz from which it continues at that level to 1 MHz.	EMECP 4.2			x			T	Y	Y	P	SSL	EMC Test Report
5.14		C) Common mode narrowband test limits are 50 dBµA (~316µA rms) from 15 kHz decreasing to 40 dBµA (100 µA rms) at 400 kHz from which it continues at that level to 1 MHz.	EMECP 4.2			x			T	Y	Y	P	SSL	EMC Test Report
5.15		D) No CE-03 broadband measurements are required.	EMECP 4.2			x			N/A	N/A	N/A	N/A	N/A	

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5.16		E) Refer to Figure 4.1&2.	EMECP 4.2			x			T	Y	Y	P	SSL	EMC Test Report
5.17	4.3. CE-07 RIPPLE AND SPIKE EMISSIONS, TIME DOMAIN	This test requirement is to demonstrate that the broadband levels of conducted ripple and spikes (both voltage and current) on input power and interface signal lines do not exceed the specified limits as observed in the time domain. Turn on, turn off, and infrequent mode change transients are covered elsewhere.	EMECP 4.3			x			T	Y	Y	P	SSL	EMC Test Report
5.18		A) Common and Differential Mode currents shall be measured on the power lines as described in section 4.1,	EMECP 4.3			x			T	Y	Y	P	SSL	EMC Test Report
		and the bulk common mode current shall be measured on all interfaces.				x			T	Y	Y	P	SSL	EMC Test Report
		Differential voltage measurements are to be made between power input and return.				x			T	Y	Y	P	SSL	EMC Test Report
		Common mode voltage measurements are to be made between a) power input and chassis, and b) power input return and chassis				x			T	Y	Y	P	SSL	EMC Test Report
5.19		B) Measurements are to be performed with a current probe and oscilloscope which, when used together, provide an AC coupled bandwidth from at least 10 Hz to 12 MHz. Voltages are to be measured with a high impedance differential input oscilloscope with at least a 50 MHz AC coupled bandwidth.	EMECP 4.3			x			T	Y	Y	P	SSL	EMC Test Report
5.20		C) Time domain conducted voltage ripple shall not exceed 1.0 V peak–to–peak for differential measurements.	EMECP 4.3			x			T	Y	Y	P	SSL	EMC Test Report
5.21		Common mode voltage shall not exceed 500 mV peak–to–peak.				x			T	Y	Y	P	SSL	EMC Test Report
5.22		D) Time domain conducted current ripple and spikes shall not exceed 300 mA peak–to–peak for differential measurements and 50 mA peak–to–peak for common mode measurements.	EMECP 4.3			x			T	Y	Y	P	SSL	EMC Test Report
5.23	4.4. CS-01 CONDUCTED SUSCEPTIBILITY, 30 HZ TO 50 KHZ	This test requirement is to demonstrate that the performance of each Subsystem is not adversely degraded by the presence of low frequency sinusoidal ripple on the primary input power lines.	EMECP 4.4			x			T	Y	Y	P	SSL	EMC Test Report
5.24		A) AC sinusoidal ripple shall be applied to the primary power input lines to produce a differential input voltage of 1.0 V peak–to–peak.	EMECP 4.4			x			T	Y	Y	P	SSL	EMC Test Report
5.25		B) Ripple current injected into the UUT shall be limited to 5 Amps peak-to-peak.	EMECP 4.4			x			T	Y	Y	P	SSL	EMC Test Report
5.26		C) Ripple frequency shall be swept over the indicated range while monitoring the Subsystem for susceptibility.	EMECP 4.4			x			T	Y	Y	P	SSL	EMC Test Report
5.27		If a continuous monitor is not available then the sweep shall be paused at appropriate intervals (e.g., 1,2,5,10) to exercise the Subsystem and record performance.				x			T	Y	Y	P	SSL	EMC Test Report
5.28		D) If susceptibility is encountered, then threshold injection levels are to be determined and recorded.	EMECP 4.4			x			D	Y	Y	P	SSL	EMC Test Report
5.29		E) Specific criteria for determining susceptibility shall be documented in the required EMC Test Procedure and approved by the EME Engineer prior to testing. At a minimum, survivability with no degradation in performance after the test is required.	EMECP 4.4			x			I	Y	Y	P	SSL	EMC Test Report

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5.30	4.5. CS-02 CONDUCTED SUSCEPTIBILITY, 50 KHZ TO 400 MHZ	This test requirement is to demonstrate that the performance of each Subsystem is not adversely degraded by the presence of high frequency sinusoidal ripple on the primary input power lines.	EMECP 4.5			x			T	Y	Y	P	SSL	EMC Test Report
5.31		A) AC sinusoidal ripple shall be applied to the primary power input lines to produce a differential input voltage of 1.0 V peak–to–peak.	EMECP 4.5			x			T	Y	Y	P	SSL	EMC Test Report
5.32		B) All test frequencies shall be pulse modulated at 1 kHz with 50% duty factor.	EMECP 4.5			x			T	Y	Y	P	SSL	EMC Test Report
5.33		C) Ripple frequency shall be swept over the indicated range while monitoring the Subsystem for susceptibility.	EMECP 4.5			x			T	Y	Y	P	SSL	EMC Test Report
5.34		If a continuous monitor is not available then the sweep shall be paused at appropriate intervals (e.g., 1,2,5,10) to exercise the Subsystem and record performance.				x			D	Y	Y	P	SSL	EMC Test Report
5.35		D) If susceptibility is encountered, then threshold injection levels are to be determined and recorded.	EMECP 4.5			x			D	Y	Y	P	SSL	EMC Test Report
5.36		E) Specific criteria for determining susceptibility shall be documented in the required EMC Test Procedure and approved by the EME Engineer prior to testing. At a minimum, survivability with no degradation in performance after the test is required.	EMECP 4.5			x			I	Y	Y	P	SSL	EMC Test Report
5.37		F) The 50 ohm 1.0 watt available power limit per MIL-STD-461B applies, i.e. ripple current injected into the UUT shall be limited to 600 milliamps peak-to-peak. If this current limit is reached, record the actual voltage level obtained.	EMECP 4.5			x			D	Y	Y	P	SSL	EMC Test Report
5.38	4.6. CS-06 CONDUCTED SUSCEPTIBILITY, SPIKES	This test requirement is to demonstrate that the performance of each Subsystem is not adversely degraded by the presence of transient spikes on the primary input power lines.	EMECP 4.6			x			T	Y	Y	P	SSL	EMC Test Report
5.39		A) Peak transient voltage, relative to nominal line voltage, for MIL-STD-461B spike #1 (slow) and spike #2 (fast) shall be 20 volts differential, 10 volts return-to-chassis.	EMECP 4.6			x			T	Y	Y	P	SSL	EMC Test Report
5.40		If a Solar Electronics Co. Model 8282-1 Transient Pulse Generator is used it shall not be set above the 100 Volt setting.				x			D	Y	Y	P	SSL	EMC Test Report
5.41		If a different pulse generator is used it shall not be set above the setting that produces 20 amps into a 5 ohm load.				x			D	Y	Y	P	SSL	EMC Test Report
5.42		B) Both positive and negative spikes are to be applied.	EMECP 4.6			x			T	Y	Y	P	SSL	EMC Test Report
5.43		C) These spikes are to be applied a) differentially to the primary power input lines and b) between primary power input return and chassis.	EMECP 4.6			x			T	Y	Y	P	SSL	EMC Test Report
5.44		D) Spikes shall be applied at a variable rate from 1 to 5 spikes per second for a duration of at least 2 minutes while monitoring the Subsystem for susceptibility per the criteria used for CS-01 and CS-02.	EMECP 4.6			x			T	Y	Y	P	SSL	EMC Test Report
5.45		E) Specific criteria for determining susceptibility shall be documented in the required EMC Test Procedure and approved by the EME Engineer prior to testing. At a minimum, survivability with no degradation in performance after the test is required.	EMECP 4.6			x			I	Y	Y	P	SSL	EMC Test Report

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5.46	**4.7. RE-01 RADIATED EMISSIONS, MAGNETIC FIELD, 10 HZ TO 50 KHZ**	This test requirement is to demonstrate that the levels of low frequency radiated magnetic field emissions from the operating Subsystem do not exceed the specified limits. The Subsystem limit will be selected from the family of curves in Figure 4.7-1 based upon the minimum distance between the UUT and the EMFISIS Search Coils and shall be measured at the specified distance of 7 cm. The specified limit spans 50 Hz to 15 kHz but measurements should go down to 10 Hz and up to 50 kHz for information only. The Subsystem is to be scanned on all sides to determine maximum emission levels. Instrument covers should be open during radiated emission testing; RF transparent covers can used to prevent contamination or the cover can be closed if approved by the EME Engineer.	EMECP 4.7			x			T	Y	Y	P	SSL	EMC Test Report
5.47	**4.8. RE-02 RADIATED EMISSIONS, ELECTRIC FIELD, 50 HZ TO 10 GHZ**	This test requirement is to demonstrate that the levels of radiated electric field emissions from the operating Subsystem do not exceed the specified limits.	EMECP 4.8			x			T	Y	Y	P	SSL	EMC Test Report
5.48		A) Shielded test interface cables may be used to reduce emissions. All flight connections shall use cables shielded in the same manner as flight cables.	EMECP 4.8			x			D	Y	Y	P	SSL	EMC Test Report
5.49		B) Low and high frequency Narrowband emission limits necessary to meet science requirements are plotted in Figure 4.8-1 and -2 when measured at the specified distance of 1 meter. Also, in the Spacecraft receiver band, 2040 +/-25 MHz, the limit is 25 dBµV/m (10 kHz resolution bandwidth and 5 dB noise figure). For devices that are on at launch in the Launch Vehicle FTS Receiver band, 408 to 430 MHz, the limit is 36.0 dBµV/m and in the Launch Vehicle CBand Transponder band, 5.687 to 5.693 GHz, the limit is 73.0 dBµV/m. All other frequencies the limit is 80 dBuV/m.	EMECP 4.8			x			T	Y	Y	P	SSL	EMC Test Report
5.50		C) For measurements below 1 kHz maximum practicable measurement sensitivity is requested and power line noise (60 Hz and harmonics) is exempted.	EMECP 4.8			x			D	Y	Y	P	SSL	EMC Test Report
5.51		D) Instrument covers should be open during radiated emission testing; RF transparent covers can used to prevent contamination or the cover can be closed if approved by the EME Engineer.	EMECP 4.8			x			D	Y	Y	P	SSL	EMC Test Report
5.52	**4.9. RS-03 RADIATED SUSCEPTIBILITY, 14 KHZ TO 18 GHZ**	This test requirement is to demonstrate that the performance of each Subsystem is not adversely degraded by the presence of high frequency radiated electric fields. The specification has two levels, an operate level where the UUT is on during the exposure and must operate with no degradation, and a survival level where the UUT must operate with no degradation after, but not during the exposure. A manual reset may be allowed for some equipment and some equipment can be off during certain bands of the test. Table 4.9-1 lists the survival limit.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report

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5.53		A) All subsystems shall operate within specification during exposure to 1 Volt/meter from 14 kHz to 15 GHz.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report
5.54		B) All subsystems shall operate within specification during exposure to 5 Volts/meter in the band 2.1 to 2.3 GHz since the Downlink transmitter may be operated at any time.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report
5.55		C) Test frequencies at and above 100 MHz shall be pulse modulated at 1 kHz with 50% duty factor.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report
5.56		Lower frequencies shall be CW.				x			T	Y	Y	P	SSL	EMC Test Report
5.57		D) Frequency shall be swept over the indicated range while monitoring the Subsystem for susceptibility.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report
5.58		If a continuous monitor is not available then the sweep shall be paused at appropriate intervals (e.g., no less than 1,2,5,10 steps and 500 MHz intervals above 1 GHz) to exercise the Subsystem and record performance.				x			D	Y	Y	P	SSL	EMC Test Report
5.59		E) If susceptibility is encountered, then threshold levels shall be determined and recorded.	EMECP 4.9			x			D	Y	Y	P	SSL	EMC Test Report
5.60		F) Specific criteria for determining susceptibility shall be documented in the required EMC Test Procedure and approved by the EME Engineer prior to testing.	EMECP 4.9			x			I	Y	Y	P	SSL	EMC Test Report
5.61		G) External interface test cables may be shielded and concealed to reduce susceptibility. All flight connections shall use cables shielded in the same manner as flight cables.	EMECP 4.9			x			D	Y	Y	P	SSL	EMC Test Report
5.62		H) The Vehicle S and C-Band field analysis from KSC is a worst case empty space analysis. Best effort shall be made to reach the C-Band test level but minimum test shall be 66 V/m.	EMECP 4.9			x			D	Y	Y	P	SSL	EMC Test Report
5.63		K) Values are adjusted from range level of 140 V/m due to shielding of transport container.	EMECP 4.9			x			T	Y	Y	P	SSL	EMC Test Report
5.64	**4.10. TURN-ON/OFF TRANSIENTS AND OPERATIONAL RANGE**	These tests are to demonstrate compliance with primary power bus interface load transient requirements so as not to stress Spacecraft power switching components, fuses, or interfere with Spacecraft performance.	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.65		A) The test power source shall have a low transient impedance (to be achieved with a 10,000 µfd, or greater, capacitor).	EMECP 4.10			EM			D	Y	Y	P	SSL	EMC Test Report
5.66		B) A power switch exhibiting less than 20 milliohms insertion resistance together with bounceless closure characteristics and no transient limiting properties shall be used for turn-On measurements.	EMECP 4.10			EM			D	Y	Y	P	SSL	EMC Test Report
5.67		C) A power switch incorporating no voltage limiting or any type of transient limiting characteristics shall be used for turn-Off measurements.	EMECP 4.10			EM			D	Y	Y	P	SSL	EMC Test Report
5.68		D) A single pulse in the inrush current or other non-repetitive transient currents for loads on the primary power bus shall be				EM			T	Y	Y	P	SSL	EMC Test Report
5.69		(1) Less than 10 Amps for less than 10 microseconds,				EM			T	Y	Y	P	SSL	EMC Test Report

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5.70		(2) Less than 4 times service rating or 2.5 amps (whichever is greater) for less than 2 milliseconds,	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.71		(3) Less than 1.8 times the service rating for less than 200 milliseconds, and				EM			T	Y	Y	P	SSL	EMC Test Report
5.72		(4) Settle to within service rating within 200 milliseconds after the start of the transient. See figure 4.10-1 for a pictorial representation.				EM			T	Y	Y	P	SSL	EMC Test Report
5.73		(5) These requirements shall be measured at the high and low voltage operational levels of the device				EM			T	Y	Y	P	SSL	EMC Test Report
5.74		E) Multiple successive pulses in the inrush current or other non-repetitive transient currents for loads on the primary power bus shall met the following requirements	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.75		1. Within any 10 second interval, the total time during which the current exceeds the rated current shall be less than 200 milliseconds.				EM			T	Y	Y	P	SSL	EMC Test Report
5.76		2. Within any 200 milliseconds interval, the total time during which the current exceeds 1.8 times the rated current shall be less than 2 milliseconds.				EM			T	Y	Y	P	SSL	EMC Test Report
5.77		3. Within any 2 ms interval, the total time during which the current exceeds the greater of 4 times the rated current or 2.5 amps shall be less than 10 microseconds.				EM			T	Y	Y	P	SSL	EMC Test Report
5.78		F) Any device failing D or E above shall be measured using the turn on circuit in figure 4.10-2 at the high and low voltage operational levels of the device. If the device passes the requirements the device meets the specification.	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.79		G) Infrequent and Short term Ripple and transient (less than 200 milliseconds duration with more than one hour between events or only occurring at an infrequent command) currents appearing at the primary power interface as a consequence of motor operation, mode changes, or other operating characteristics, shall not exceed a peak-to-peak value of a) 0.7 times the nominal operating current, or b) 0.5 amperes, whichever is greater, as observed in the time domain using a bandwidth of at least 50 MHz	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.80		H) Primary power voltage transients superimposed on the DC voltage shall not exceed +56 to -2 volts absolute for 0.015 milliseconds. (Note. For analysis in support of this test the source can be assumed to have a characteristic impedance of 200 milliohms resistance with an inductance of 3 microhenrys together with a resistance of 100 ohms in parallel with the inductor.)	EMECP 4.10			EM			T	Y	Y	P	SSL	EMC Test Report
5.81	**4.11. ESD CHARACTERIZATION TEST FOR SPACECRAFT DISCHARGE MITIGATION**	The purpose of this test is to simulate the electromagnetic pulse that could occur OUTSIDE a device if something on the spacecraft creates a discharge due to electron charging. The model in figure 3.1.1-2 b shows that the discharge can be up to 5000 Volts	EMECP 4.11			EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report

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5.82		A) All subsystems shall operate within specification after exposure to Ten air discharges of 5000 Volts from an approved Human Body Model (HBM) ESD Gun to the ground plane the device is on at a position about 25 cm from each face of the device. (four tests with 40 pulses total)	EMECP 4.11			EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.83		B) If susceptibility is encountered, then threshold levels shall be determined and recorded.	EMECP 4.11			EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.84		C) There shall be no major upsets of the device function requiring operator intervention or power cycling	EMECP 4.11			EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.85		and the device shall function within specification after the discharges.				EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.86		Any minor upset, such as communications glitch or memory error shall be reported.				EM			T	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.87		D) External interface test cables may be shielded and concealed to reduce susceptibility. All flight connections shall use cables shielded in the same manner as flight cables.	EMECP 4.11			EM			D	Y	Y	P	SSL	DDD/ Discharge Test on ETU Test Report
5.88	**4.12. MAGNETIC SNIFF TEST**	This test is to demonstrate compliance with the system level requirements of less than 5 nT static and 0.1 nT dynamic time domain magnetic fields at the Magnetometer. There is no set failure limit, the magnet moment (or magnetic field at a stated distance) shall be measured in all operational modes so differences in the static field can be determined and compared to the dynamic limit.	EMECP 4.12			FM			T	Y	Y	P	APL	DC Magnetics Incoming Survey; APL has verified this requirement during integration per integration procedures, 9417-9773
5.89		A) Care should be taken to assure all cables keep every signal and power twisted with the proper return to reduce magnetic emissions. Shielded test interface cables may be used.	EMECP 4.12			FM			D	Y	Y	P	APL	DC Magnetics Incoming Survey; APL has verified this requirement during integration per integration procedures, 9417-9773
5.90		B) Care should be take to assure the ambient magnetic field is properly removed from the measurements.	EMECP 4.12			FM			D	Y	Y	P	APL	DC Magnetics Incoming Survey; APL has verified this requirement during integration per integration procedures, 9417-9773
5.91		C) The EMFISIS Team and the EME Engineer are willing to assist in defining and performing the required testing.	EMECP 4.12			FM			T	Y	Y	P	APL	DC Magnetics Incoming Survey
6.	**8.1. ACCEPTANCE TESTS**													
6.1		The test procedures in section 5.4, or equivalent procedures with prior approval, shall be used.	EMECP 8.1						T	Y	Y	P	SSL	EMC Test Report
6.2		If the certification item is tested with either different loads or procedures, it shall be retested to the identical conditions of the rest of the equipment set.	EMECP 8.1						T	Y	Y	P	SSL	EMC Test Report