Best Practices: Power Quality and Integrated Testing at JSC

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Validate your Design through Qualification Testing, 
Certify your Workmanship through Acceptance Testing.

- Ideally, Project Developers will first deliver an Engineering Unit to verify the design can pass Power Quality testing.
  - Design changes may be required

- After any necessary design changes, a flight-like Qualification (Qual) Unit is delivered, which is used to validate Power Quality and project requirements.

- Perform Qualification Testing to validate your design at extreme worst-case conditions
  - Thermal Cycling, Random Vibration, Vacuum, Thermal/Vacuum, Radiation, Power Quality, EMI, Functional Testing, etc.

- Once the design passes Qualification Testing, a Flight Unit should be delivered.

- Verify your workmanship through Acceptance Testing on the Flight Unit
  - Electrical Functional Test (EFT), expected temperatures, expected vibration, nominal load
  - Enables the Project Developer’s Flight Unit to be verified, without exposing it to extreme conditions experienced during Qualification Testing
Multiple individuals should verify test setup and configurations prior to power-up.

- At least 3 different people should verify test setup and cable configurations
  - Typically Test Director, Tech/Test Assistant, and an Independent Reviewer (IR)
  - Flight Hardware should always be verified by the customer, and requires 2 additional Quality personnel for verification

- Perform a Reverse Polarity Check prior to power-up
  - Complete cable configuration up to Unit Under Test (UUT), without mating UUT connectors
  - Apply power, and use a Digital Multimeter (DMM) to verify polarity of the source
  - If results are as expected, mate UUT connectors, and proceed with testing.
Automate Testing, when possible.

- Standard JSC Power Quality testing includes Impedance & EMI Testing which involves hundreds of measurements at various frequencies.

- We developed an automated software program that will control the test equipment to take measurements while sweeping through all of the required frequencies and test cases.

- Automating standard tests will reduce effort, errors, and schedule impacts, and improves test turn-around time.
Perform Integrated Testing in the final flight configuration.

- Newly designed Solid State Lighting Assembly (SSLA) upgraded International Space Station (ISS) internal lighting.
  - New design was retro-fitted into existing light locations
  - System Remote Control Assembly (SRCA) connects to many lights, and controls multiple lights in one module.

- Individual SSLAs successfully passed Power Quality requirements

- However, once SSLAs were installed on ISS, SRCAs did not properly control 5+ SSLAs in parallel.

- New design causes SRCA capacitors that provide a pulse to the control circuit of the SSLA to discharge too rapidly; preventing all SSLAs controlled by that particular switch from receiving the control pulse.
  - Integrated flight-like configuration SRCA/SSLA testing would have identified this problem prior to flight