AIAA S-133-4-2013

# Standard

# Space Plug-and-Play Architecture Standard

## Physical Interface

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**Sponsored by**

American Institute of Aeronautics and Astronautics

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**Abstract**

The Space Plug and Play Architecture (SPA) Physical Interface specifies the mechanical requirements and physical mounting considerations for SPA devices and panels.

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## Foreword

This standard was developed through a partnership of the Air Force Research Laboratory Space Vehicles Directorate, the Air Force Office of Operationally Responsive Space, numerous government contractor teams, independent contractor teams, and academic experts. The Space Plug-and-Play Architecture is a collection of standards developed to facilitate rapid constitution of spacecraft systems using modular components. In order for a SPA system to meet expected performance requirements, the SPA components and spacecraft must conform to a consistent and widely agreed upon grounding approach. This document includes specifications for SPA device and panel mechanical features.

This particular volume of the SPA Physical Interface Standard contains information not recorded in previous documentation. It is part of a set of 10 documents describing other components of the standard:

- SPA Guidebook
- SPA Networking Standard
- SPA Logical Interface Standard
- SPA 28V Power Service Standard
- SPA System Timing Standard
- SPA Ontology Standard
- SPA Test Bypass Standard
- SPA SpaceWire Subnet Adaptation Standard
- SPA System Capability Guide

At the time of approval, the members of the AIAA SPA Standards Committee were:

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|---|---|
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The above consensus body approved this document in April 2013.

The AIAA Standards Executive Council (VP-Standards Laura McGill, Chairperson) accepted the document for publication in May 2013.

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*Alternate CoS participant.

## Introduction

The space plug-and-play architecture (SPA) standards are a collection of documents designed to facilitate rapid constitution of spacecraft systems using modular components. This document details the features for mechanical mounting, thermal control and interface connectors of SPA devices on a SPA-compliant spacecraft.

The standard mechanical interface is a bolted connection to a regularly spaced grid of threaded holes. The grid spacing and fastener size are specified.

Thermal control of SPA devices is accomplished by the rejection of dissipated power to the mounting surface (conduction) or to the surrounding environment (radiation). The spacecraft provides a conductive interface for the SPA devices; however, the device designer may choose other approaches such as heat rejection to space via radiators.

The SPA electrical connector interface consists of one or more connectors that contain provisions for power, data, a timing synchronization pulse, grounding connections, and (if specified) a Test Bypass (TB) data interface.

There are two broad categories of requirements specified in this document that must be satisfied for integration of SPA devices. First, specific interface requirements must be met by both SPA devices and the SPA spacecraft, such as mounting hole pattern dimensions. Second, SPA device data must be provided with the item at the time of delivery. This data allows the SPA spacecraft developer to configure the spacecraft for proper integration and operation of the SPA device.

# 1 Scope

Mechanical, thermal and electrical connector interface requirements are contained in this document. These requirements include details of the mounting hole pattern, fastener clearance-hole sizes, and thermal control approaches.

Reporting requirements for mechanical and thermal design data, such as mass, center of gravity, envelope, radiator and heater locations, and so forth are described.

This standard does provide some limited electrical interface requirements. Electrical power service requirements are included in AIAA S-133-5-2013. A more extensive common reference for both standards is AIAA S-122-2007, *Electrical Power Systems for Unmanned Spacecraft*. This document identifies the significant features of the SPA interface connector(s) and the associated cabling to allow SPA device and cable manufacturers to build systems that interconnect successfully with SPA-enabled spacecraft. The connector type and pin assignments are described, along with definitions of connector gender and mechanical mounting. Requirements are provided for the associated cabling, including details of shielding, shield termination, insulation and cable impedance

Optional SPA connector interfaces are described in the following sections by type (i.e., Type A, Type B, etc.).

# 2 Tailoring

When viewed from the perspective of a specific program or project context, the requirements defined in this Standard may be tailored to match the actual requirements of the particular program or project. Tailoring of requirements shall be undertaken in consultation with the procuring authority where applicable.

NOTE Tailoring is a process by which individual requirements or specifications, standards, and related documents are evaluated and made applicable to a specific program or project by selection, and in some exceptional cases, modification and addition of requirements in the standards.

# 3 Applicable Documents

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

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| AIAA S-122-2007 | *Electrical Power Systems for Unmanned Spacecraft* |
| AIAA G-133-1[illegible]2013 | *Space Plug-and-Play Architecture Guide System Capabilities* |
| AIAA S-133-5-2013 | *Space Plug-and-Play Architecture Standard 28V Power Service* |
| ECSS-E-ST-50-12C | *SpaceWire Cabling* |
| GSFC S311-P-4 | *Connectors: Electrical, Subminiature, Rack and Panel* |
| MIL-DTL-24308 | *Connectors: Electric, Rectangular, Nonenvironmental, Miniature, Polarized Shell, Rack and Panel* |
| MIL-DTL-83513 | *Connectors: Electric, Rectangular, Microminiature, Polarized Shell* |