

# ***PMPedia™: A Crowd-Sourced Alternate-Grade\* Electronics Space Radiation Knowledge Repository***



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**\*Alternate-Grade = automotive, COTS, industrial, medical, military terrestrial**



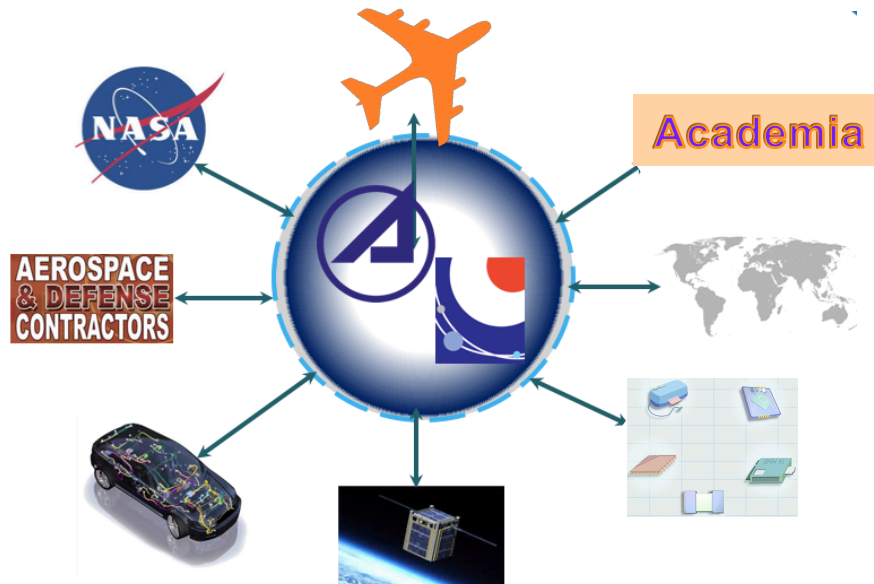
# ***Agenda***

- PMPedia™ (**P**arts, **M**aterials, **P**rocesses) Encyclopedia  
Motivation
- Functional Overview
- Access
- Conclusion and Invitation to Collaborate

# PMPedia™ (Parts, Materials, Processes) Encyclopedia



- Need a readily-accessible alternate-grade electronics data repository for the space community
  - Reduce duplicative and/or non-value added testing and analyses
  - Save space system development and production costs
  - Deliver reliable, resilient systems more quickly
- [www.PMPedia.space](http://www.PMPedia.space) (Beta) deployed August 2019
  - Seeded with Aerospace Corporation and LASP data. We need more data!
  - Emphasis on radiation test data
  - Destructive and non-destructive physical analyses and more



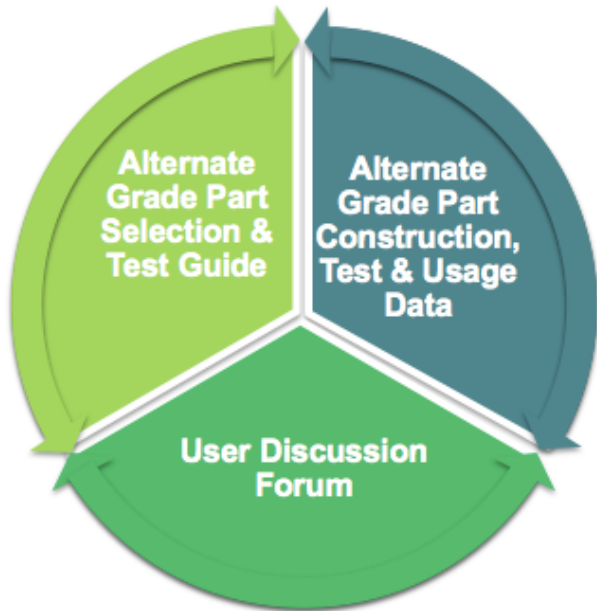
Awaiting  
YOUR  
participation  
and data  
contributions!

**Crowd Sourced repository provided by The Aerospace Corporation and the University of Colorado-Boulder's Laboratory for Atmospheric and Space Physics (LASP)**

# PMPedia™ Functions and User Interface



[www.PMPedia.space](http://www.PMPedia.space)



Home About Guidance Parts Upload test data Forums

## Parts, materials, and processes encyclopedia

### Build spaceflight-ready systems faster and cheaper with alternate-grade products

*Get appropriate guidelines for testing parts*

**VIEW TEST GUIDANCE**

*Easily find suitable parts for your spaceflight mission*

**FIND PARTS**

*Get help from others in our forum*

**EXPLORE THE FORUM**

*Contribute to PMPedia by uploading your own test data*

**UPLOAD TEST DATA**

Rapidly-evolving needs for reliable Small Satellites, resilient systems, technology demonstrations, experiments and short-duration missions have generated intense interest in alternate-grade EEE (electrical, electronic, electromechanical) products. These automotive, COTS and industrial grade products offer the benefits of advanced capabilities, ready availability and low procurement cost.

However, individual users often have to independently test and analyze the products since their space performance, especially natural radiation sensitivity, may be unknown. While necessary, this practice is duplicative, costly and time-consuming, eroding the benefits that make the products attractive in the first place.

To reduce this duplication of effort and get data into the hands of users more quickly and inexpensively, The Aerospace Corporation and the Laboratory for Atmospheric and Space Physics at the University of Colorado Boulder have partnered to create a crowd-sourced, encyclopedic parts, materials and processes (PMP) knowledge repository for alternate-grade products. The repository, known as **PMPedia** (Parts, Materials, and Processes Encyclopedia), is a place where organizations across the space enterprise can share selection and test guidance, search for non-proprietary test and analysis data on specific part types, and exchange PMP experiences in a moderated user forum.

PMPedia's goal is to help users harvest the benefits of alternate-grade products so they can accelerate the design, manufacture and deployment of less costly, more capable systems.





# Alternate Grade EEE Parts Selection & Test Guidance

Alternate Grade Part Selection & Test Guide

**Workflow based on Mission attributes: Orbit, Duration, Cost, Risk**

**Content will evolve as user community experts offer updates and refinements**

**Guidance results**

Select a part type to view requirements.

**Diode**

- Source
  - COTS acceptable, AEC preferred
- Radiation qualification testing (assumes 100 mils aluminum shielding on spacecraft vehicle)
  - Total dose 10 KRad - Recommended, but not required
  - Single event upset - Not required
- Upscreen
  - Not required
- Vacuum bake
  - Recommended if optical surfaces are present
- Burn-in at assembly level to MPE  $\pm 10^{\circ}\text{C}$ 
  - 50 hours at assembly level required, elevated temperature (85°C) recommended

Resistor  
Capacitor  
FET  
Logic  
FPGA  
 $\mu$ Processor

**Common-sense, tailored guidance**

- **Facilitates meeting program and customer requirement flow-downs**
- **Reduces duplicative and/or non-value added testing and analyses**
- **Accelerates alternate grade parts decision-making**



# Alternate Grade EEE Parts Test Data Repository

(no image)

**Analog Devices AD7983BRMZ**  
**Analog-to-Digital Converter, 16-Bit, 1.33 MSPS PuISAR in MSOP/QFN**  
Suggested orbits:

## Radiation test results

<b>Beam testing</b>	SEE Testing, Xe ions
<b>Objective</b>	SEL
<b>Flux (max)</b>	2e4 protons/cm <sup>2</sup> /sec
<b>Proton dose</b>	50000 Rad(Si)
<b>Test condition</b>	4 units, decapped, monitor current draw on 3.3V and 5V ADC power lines

sample 1: run-away current (latch-up),  
samples 2 and 3: transient current  
increases

Alternate  
Grade Part  
Construction,  
Test & Usage  
Data

*Example part data*

## Test analysis

## Technical documents

Size: 5.41 MB  
Filetype: application/pdf

**Download**

- ***Growing list of part types. (We need more, please!)***
- ***Data types: various radiation test data (TID, SEE, SEU), physical analyses, images***
- ***Suggestions for devices and circuit cards for upcoming radiation tests are welcome***



# Alternate Grade EEE Parts User Discussion Forum



My Account ▾ Part Reliability 🔍

Top Questions — Minimize × Close

**I did not do radiation testing on my SmallSat COTS microprocessor prior to launch and now have 11 months of successful LEO flight history. I'm now building the next vehicle. How do I take "reliability credit" for my on-orbit experience?**  
Answered by PMPedia community 52  
To take reliability credit, submit your orbital parameters, shielding and derating data to Aerospace for vetting. Sounds like really great results, looking forward to seeing the data!

**I chose an XYZ component for my 3-yr mission design based on the data sheet. Why isn't that good enough? Why would I need to test the parts in advance prior to populating my subsystem boards to make it reliable?**  
Answered by The Aerospace Corporation 23  
Please refer to the requirements [PMPedia](#) for guidelines into testing approaches. Your particular approach should be based on your mission risk tolerance among other things.

**I know that a specific COTS subsystem delivers much more capability for less cost, delivery time, space and power. But my risk-averse customer specifies the parts I must use. What evidence could I provide that would build confidence in this COTS subsystem reliability that is used by the millions in non-space applications?**  
Answered by PMPedia community 89



- Moderated forum
  - Q & A
  - *Parts application advice*
  - *Common practices*
  - *Experience sharing*
- User feedback on improvements to PMPedia™ content and usability

# How to Access PMPedia™



- PMPedia™ is crowd-sourced and relies upon (welcomes!) user inputs
- To access Test and Selection Guidance, and the Parts Repository, visit [www.PMPedia.space](http://www.PMPedia.space)
- To request a login and participate in the User Forum, visit <https://cms.pmpedia.space/wp-login.php?action=register>

## User Login Account Request

### PMPediaRequests

Request for access to PMPedia Forums and data upload

\* Required

Email address \*

Your email

Affiliation \*

Your answer

Willing to share your data with community? \*

Yes

No

First Name

Your answer

Last Name

Your answer

SUBMIT

Never submit passwords through Google Forms.

**PMPedia™** beta  
Parts, Materials, and Processes Encyclopedia

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### User Forum

Created by Thomas Baltzer, last modified by Neil White on Aug 05, 2019

*If you wish to return to the PMPedia.Space website, click here.*

*For questions and comments, please email: [PMPedia.Development@lasp.colorado.edu](mailto:PMPedia.Development@lasp.colorado.edu).*

These forums are intended to help disseminate information, ask questions, and make suggestions. Anybody can read these messages, but you need to login to post.

[Request login](#)

Please note that by logging on you agree to the terms of service and that we reserve the right to remove any posts we deem inappropriate. Repeated abuse will lead to removal of login privileges.





## **Conclusion**

- PMPedia's goal is to enable data sharing and expedite advanced, reliable alternate grade parts in space systems
  - *Crowd-sourced non-proprietary data, and selection and test guidance*
  - *Open forum for knowledge exchange*
- Accelerate efficient, cost-effective development and fielding of reliable, resilient systems
- The PMPedia™ team welcomes your participation
  - [PMPedia.Development@lasp.colorado.edu](mailto:PMPedia.Development@lasp.colorado.edu)
- If you have a site to which we can link, please let us know

## ***The authors acknowledge the collaboration and support of:***

- The Aerospace Technical Investment Program
- CU-Boulder/Laboratory for Atmospheric and Space Physics
- NASA - Goddard Space Flight Center, Ames Research Center

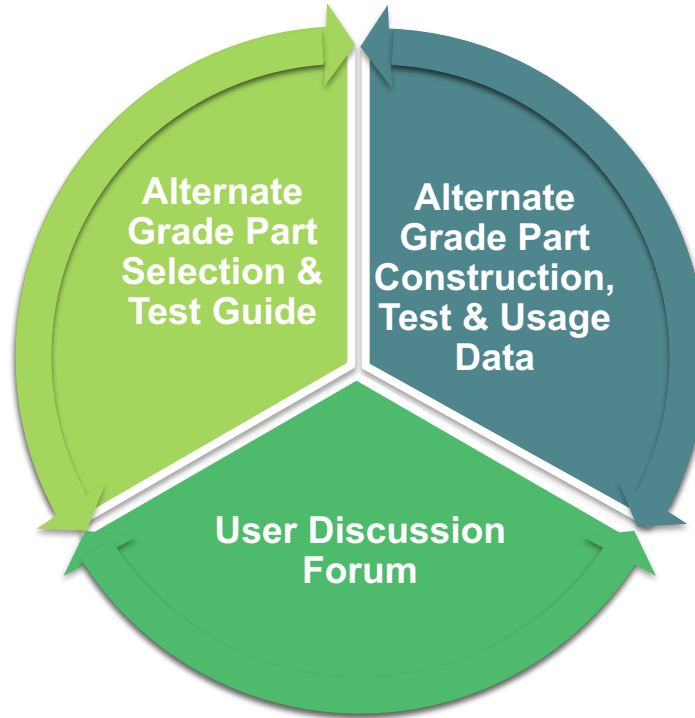
# ***Backup***



# Crowd Sourced Knowledge Repository – PMPedia™



- “Dynamic” standard refreshed continuously
- Workflow driven, common sense parts guide
- Usage requirements tailored to mission orbit, duration, cost, risk
- Facilitates meeting program and customer requirement flow-downs



- Shared knowledge repository for entire Space community
- Big Data analytics applied to parts construction artifacts and test results
- Radiation testing and various analyses

- Discuss what has worked in space, what didn't
- Space community knowledge exchange moderated by subject matter experts

***Knowledge Repository for Reliable Alternate Grade EEE Parts Usage in Space***  
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# Alternate Grade EEE Parts Test Data Repository

The screenshot shows the PMPedia website interface. The browser address bar displays 'https://pmpedia.space/#/parts'. The page header includes the 'PMPedia beta' logo and navigation links for Home, About, Guidance, Parts, and Forum. A search icon is also present. On the left, there are two filter sections: 'Category' and 'Manufacturer'. The 'Category' section includes options like Discrete semiconductors, Diode, Transistor, Fiber Optics, Filters, Fuses, Heaters, Hybrids, and Integrated circuits. The 'Manufacturer' section lists companies such as Abracon LLC, Analog Devices, Diodes Inc, Fairchild/On Semi, Maxim, Maxim Integrated, Microchip, Microchip Technology, and Microsemi. The main content area, titled 'Showing all parts', lists several components with their part numbers and descriptions:

- Vishay Si7454: 100V N-Channel MOSFET
- Vishay Si7489: 100V P-Channel MOSFET
- Diodes Inc DMP3099: 30V P-Channel MOSFET
- Xilinx XCZU9EG-FFVB1156: Zynq UltraScale+ SOC
- Fairchild/On Semi 1N914BW: Small Signal Fast Switching Diode
- Abracon LLC ABM8G-14.7456MHZ-18-D2Y-T: CRYSTAL 14.7456MHZ 18PF SMD
- Texas Instruments ADS7958QDBTRQ1: Automotive 8 bit, 1 MSPS, 4 Channel, Single-Ended, SAR ADC
- Texas Instruments ADS7959QDBTRQ1: Automotive 8 bit, 1 MSPS, 8 Channel, Single-Ended, SAR ADC
- Microchip Technology ATMEGA1280-16AU: MCU 8BIT 128KB FLASH 100TQFP

Alternate Grade Part Construction, Test & Usage Data

- **Growing list of part types. (We need more, please!)**
- **Data types: various radiation test data (TID, SEE, SEU), physical analyses, images**
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