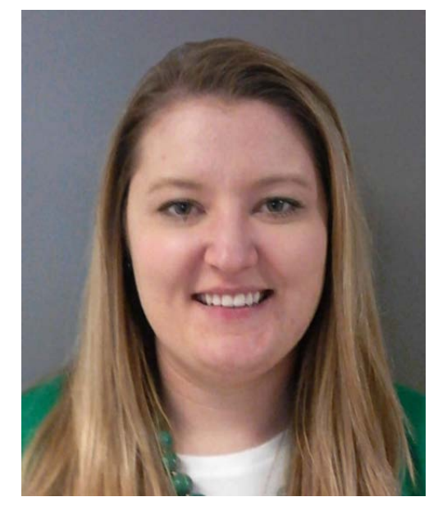
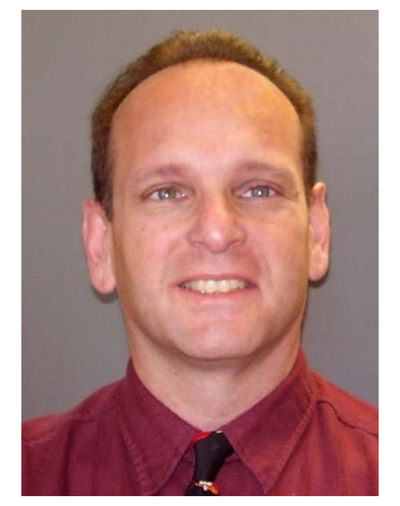
Martha O'Bryan



Megan Casey

Jean-Marie Lauenstein



Ken LaBel

Resources for Radiation Test Data

Martha V. O'Bryan[1], Megan C. Casey[2], Jean-Marie Lauenstein[2], and Kenneth A. LaBel[2]

1. AS&D, Inc.; 2. NASA GSFC

National Aeronautics and
Space Administration

Abstract: We present resources for aerospace engineers or spacecraft design engineers to use when searching for radiation test data.

Introduction

The performance of electronic devices in a space radiation environment is often limited by susceptibility to single-event effects (SEE), total ionizing dose (TID), and displacement damage (DD). Interpreting the results of SEE, TID, and DD testing of complex devices is quite difficult given the rapidly changing nature of both technology and the related radiation issues. As such, radiation test data are most often application-specific and an adequate understanding of the test conditions is critical [1].

Radiation testing is performed to establish the sensitivities of candidate spacecraft electronics to single-event upset (SEU), single-event latchup (SEL), single-event gate rupture (SEGR), single-event burnout (SEB), single-event transients (SETs), single event functional interrupts (SEFIs), TID, and DD effects. Knowing where to search for these test results is a valuable resource for the aerospace engineer or spacecraft design engineer.

Resources for Radiation Test Data

- National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Radiation Effects and Analysis Group (REAG) website provides detailed REAG test reports, see http://radhome.gsfc.nasa.gov/. REAG test reports are also available on the NASA Electronic Parts and Packaging (NEPP) Program website, see https://nepp.nasa.gov/.
- Defense Logistics Agency (DLA) Land and Maritime, the largest Inventory Control Point (ICP) in the DLA. Their website manages over 1.6 million S9C (Construction) and S9E (Electronics) spare parts and their website allows a search on any page within the site for any subject, see http://www.landandmaritime.dla.mil/. The specific mission of DLA Land and Maritime Sourcing and Qualifications Division (VQ) is to establish and maintain a known-good supplier base that have successfully demonstrated their products met the specified performance, quality, and reliability levels via the Department of Defense (DoD) Product Qualification Program.
- Individual copies of full papers published in the Institute of Electrical and Electronics Engineers (IEEE) Transactions on Nuclear Science and Radiation Effects Data Workshop (REDW) are available online at IEEE Xplore, see http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=23 or http://ieeexplore.ieee.org/xpl/conhome.jsp?punumber=1000609.
- The IEEE Radiation Effects Data Workshop (REDW) Record website provides a reference index of radiation effects piece-part testing data, organized by year of publication in the REDW Record, see http://www.nsrec.com/redw/.
- European Space Components Coordination (ESCC) European Space Components Information Exchange System, see https://escies.org/labreport/radiationList.
- The Jet Propulsion Laboratory provides data on their JPL RAD Archive website, see http://radcentral.jpl.nasa.gov/.
- Some companies that provide radiation effects analysis and test services also provide test results, *i.e.*, Munir Shoga's Radiation Group, Inc., see http://www.rad-data.net/index.html.
- Some individual manufactures have websites that provide parts test data, including, but not limited to:
  - Texas Instruments' Radiation Data for Space site, which also includes data from previous National Instruments parts, see http://www.ti.com/lsds/ti/high-reliability/space/radiation-data.page
  - International Rectifier http://hirel.irf.com/,
  - Aeroflex http://www.aeroflex.com/ams/pagesfamily/fams-hirel.cfm,
  - Intersil http://www.intersil.com/en.html,
  - Honeywell http://www.honeywellmicroelectronics.com/, and
  - ST Microelectronics http://www.st.com/web/en/home.html.
- Search engines, such as Google, are also useful resources.

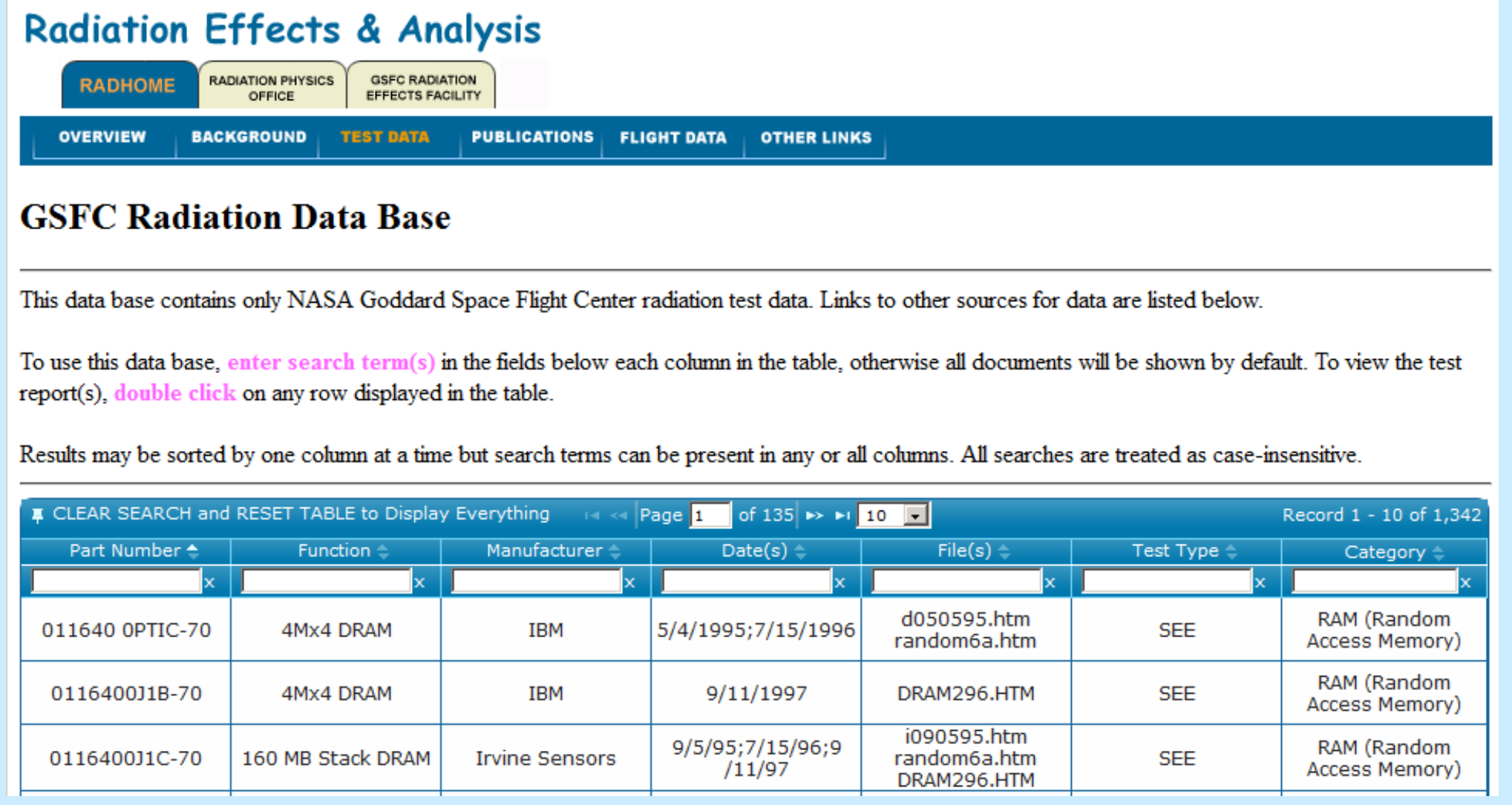
Acronyms

DD = displacement damage (DD)
DLA = Defense Logistics Agency (DLA) (formerly Defense Supply Center Columbus [DSCC])
DoD = Department of Defense (DoD)
ESCC = European Space Components Coordination (ESCC)
GSFC = Goddard Space Flight Center (GSFC)
ICP = Inventory Control Point (ICP)
IEEE = Institute of Electrical and Electronics Engineers (IEEE)
NASA = National Aeronautics and Space Administration (NASA)
NEPP = NASA Electronic Parts and Packaging (NEPP)
QML = Qualified Manufacture List (QML)
REAG = Radiation Effects and Analysis Group (REAG)
REDW = Radiation Effects Data Workshop (REDW)
RHA = Radiation Hardness Assured (RHA)
SEB = single-event burnout (SEB)
SEE = single-event effects (SEE)
SEFIs = single event functional interrupts (SEFIs)
SEGR = single-event gate rupture (SEGR)
SEL = single-event latchup (SEL)
SETs = single-event transients (SETs)
SEU = single-event upset (SEU)
SRAM = Static Random Access Memory (SRAM)
TID = total ionizing dose (TID)

Test Data Research Samples

NASA GSFC Radiation Effects and Analysis Group (REAG)

The REAG radhome website allows searching of the database containing over 1,300 parts. The parts search interface allows narrowing the search by specific fields including part number, function, manufacturer, test dates, test report file name, test type, and category. Figure 1 shows the radhome search interface. Figure 2 shows how to access individual test reports .



GSFC Radiation Data Base

This data base contains only NASA Goddard Space Flight Center radiation test data. Links to other sources for data are listed below.

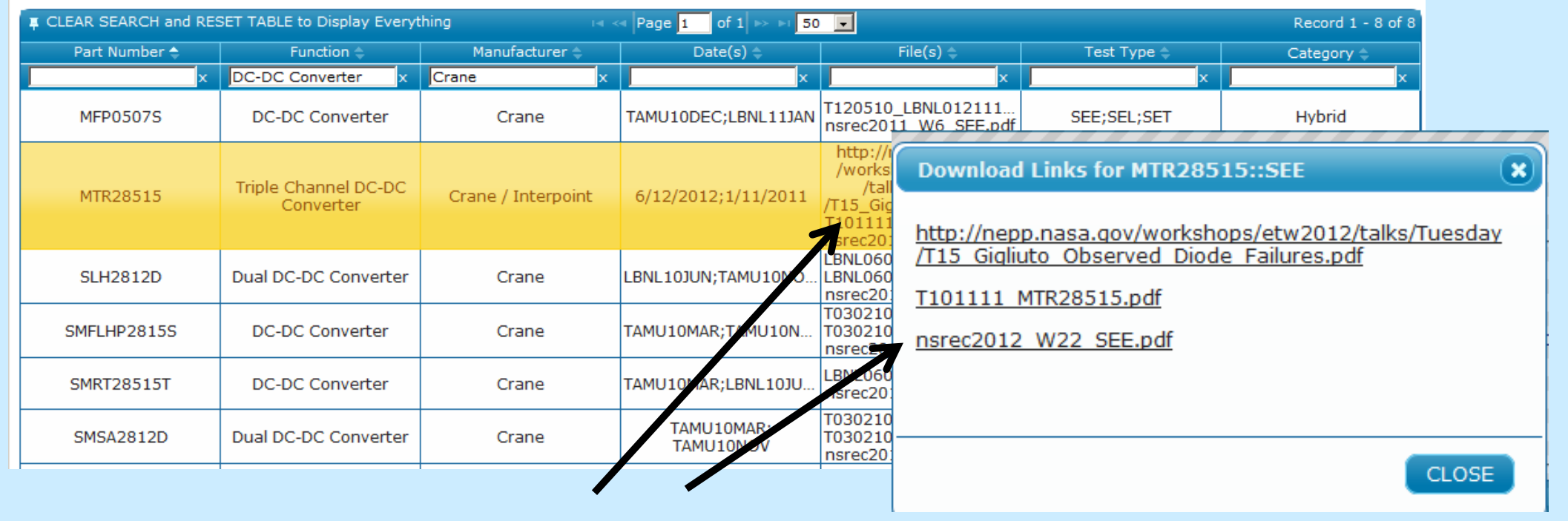
To use this data base, enter search term(s) in the fields below each column in the table, otherwise all documents will be shown by default. To view the test report(s), double click on any row displayed in the table.

Results may be sorted by one column at a time but search terms can be present in any or all columns. All searches are treated as case-insensitive.

CLEAR SEARCH and RESET TABLE to Display Everything   Page 1 of 135   10   Record 1 - 10 of 1,342

Part Number	Function	Manufacturer	Date(s)	File(s)	Test Type	Category
011640 0PTIC-70	4Mx4 DRAM	IBM	5/4/1995;7/15/1996	d050595.htm random6a.htm	SEE	RAM (Random Access Memory)
0116400J1B-70	4Mx4 DRAM	IBM	9/11/1997	DRAM296.HTM	SEE	RAM (Random Access Memory)
0116400J1C-70	160 MB Stack DRAM	Irvine Sensors	9/5/95;7/15/96;9/11/97	i090595.htm random6a.htm DRAM296.HTM	SEE	RAM (Random Access Memory)

Figure 1. NASA GSFC REAG radhome web searchable parts interface.



CLEAR SEARCH and RESET TABLE to Display Everything   Page 1 of 1   50   Record 1 - 8 of 8

Part Number	Function	Manufacturer	Date(s)	File(s)	Test Type	Category
	DC-DC Converter	Crane				
MFP0507S	DC-DC Converter	Crane	TAMU10DEC;LBNL11JAN	T120510_LBNL012111... nsrec2011_W6_SEE.pdf	SEE;SEL;SET	Hybrid
MTR28515	Triple Channel DC-DC Converter	Crane / Interpoint	6/12/2012;1/11/2011			
SLH2812D	Dual DC-DC Converter	Crane	LBNL10JUN;TAMU10NO...			
SMFLHP2815S	DC-DC Converter	Crane	TAMU10MAR;TAMU10N...			
SMRT28515T	DC-DC Converter	Crane	TAMU10MAR;LBNL10JU...			
SMSA2812D	Dual DC-DC Converter	Crane	TAMU10MAR; TAMU10NOV			

Download Links for MTR28515::SEE

http://nepp.nasa.gov/workshops/etw2012/talks/Tuesday/T15_Gigliuto_Observed_Diode_Failures.pdf

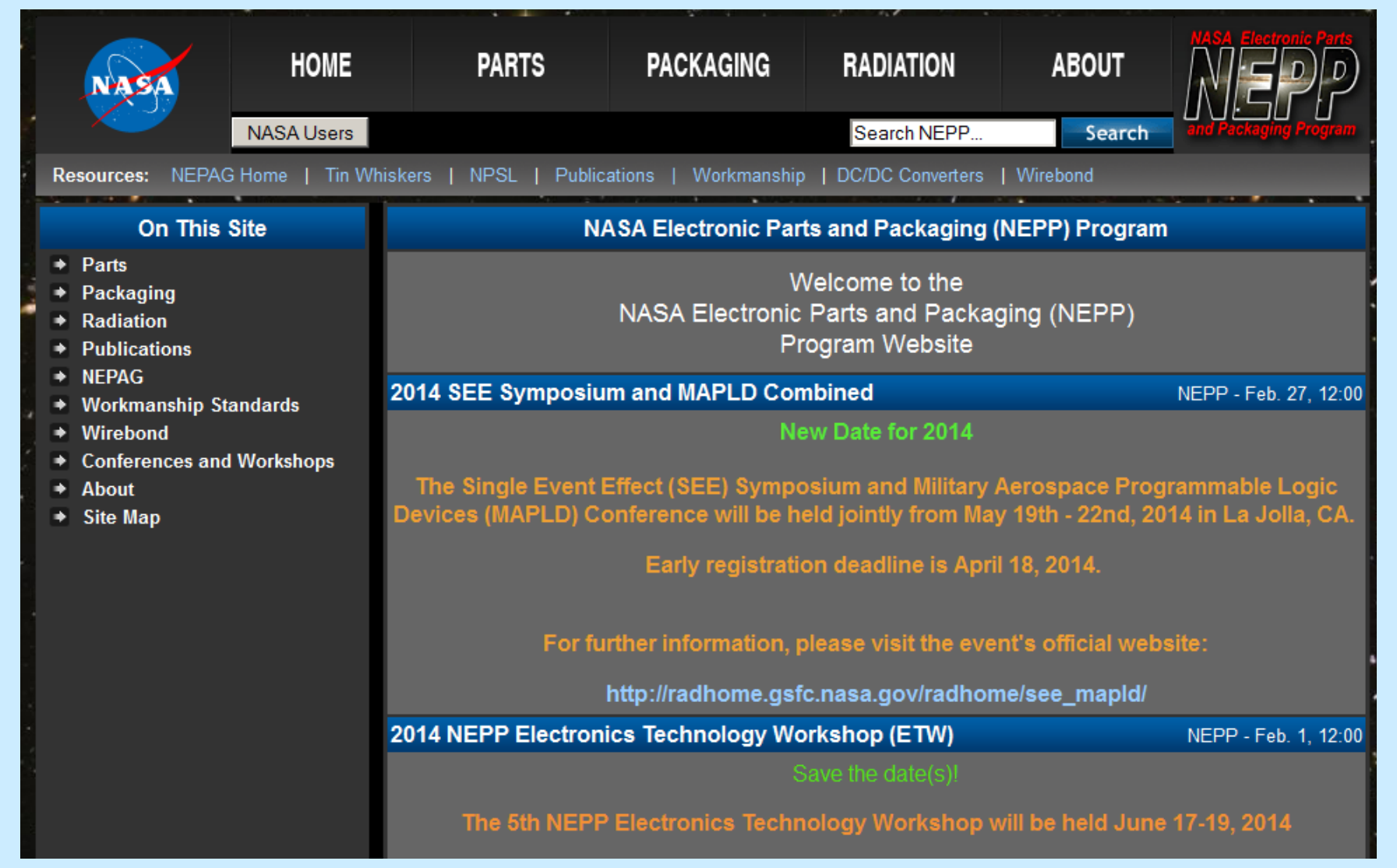
T101111_MTR28515.pdf

nsrec2012_W22_SEE.pdf

Figure 2. Search results for DC-DC Converters manufactured by Crane. Click on files and a pop-up window shows links to individual test reports .

NASA Electronic Parts and Packaging (NEPP)

The NEPP search tool allows Google searches of the NEPP web resources. Figure 3 shows the NEPP search interface.



NASA Electronic Parts and Packaging (NEPP) Program

Welcome to the
NASA Electronic Parts and Packaging (NEPP)
Program Website

2014 SEE Symposium and MAPLD Combined   NEPP - Feb. 27, 12:00

New Date for 2014

The Single Event Effect (SEE) Symposium and Military Aerospace Programmable Logic Devices (MAPLD) Conference will be held jointly from May 19th - 22nd, 2014 in La Jolla, CA.

Early registration deadline is April 18, 2014.

For further information, please visit the event's official website:

http://radhome.gsfc.nasa.gov/radhome/see_mapld/

2014 NEPP Electronics Technology Workshop (ETW)   NEPP - Feb. 1, 12:00

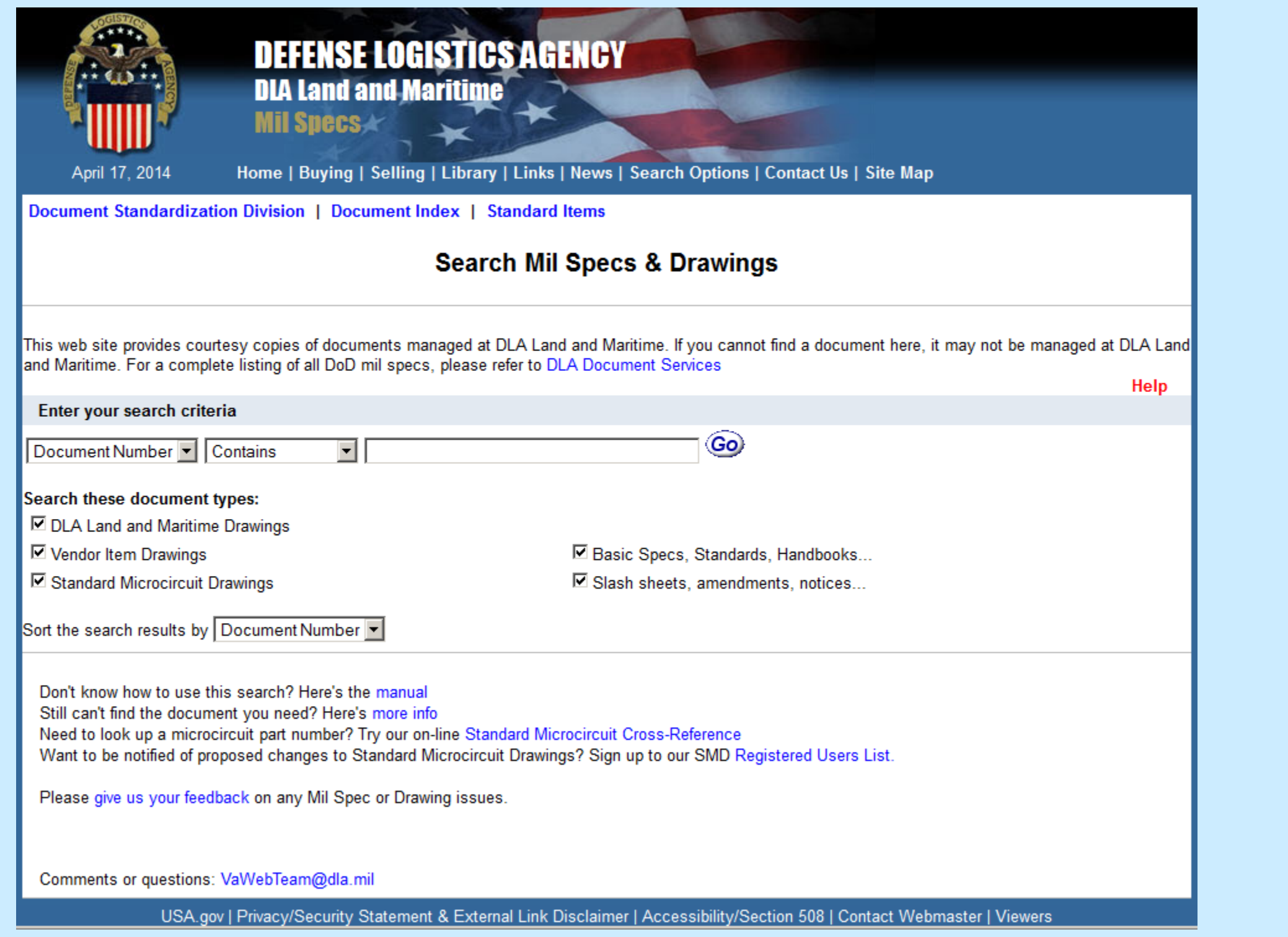
Save the date(s)!

The 5th NEPP Electronics Technology Workshop will be held June 17-19, 2014

Figure 3. NEPP search tool allows Google searches of the NEPP web resources.

Defense Logistics Agency (DLA) Land and Maritime

The search Mil Specs & Drawings interface offers the ability to search all of the military specifications and SMDs for which DLA Land and Maritime maintains qualification data. Figure 4 shows a screen capture of the search interface. Figure 5 shows the radiation features search results for a sample part.



Search Mil Specs & Drawings

This web site provides courtesy copies of documents managed at DLA Land and Maritime. If you cannot find a document here, it may not be managed at DLA Land and Maritime. For a complete listing of all DoD mil specs, please refer to DLA Document Services

Enter your search criteria

Document Number ▾   Contains ▾   Go

Search these document types:

☑ DLA Land and Maritime Drawings
☑ Vendor Item Drawings
☑ Standard Microcircuit Drawings
☑ Basic Specs, Standards, Handbooks...
☑ Slash sheets, amendments, notices...

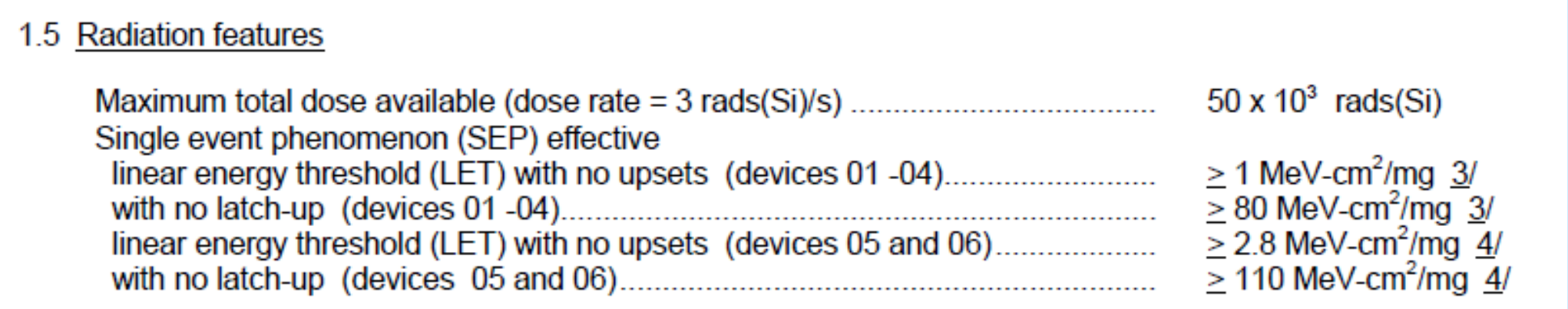
Sort the search results by Document Number ▾

Don't know how to use this search? Here's the manual
Still can't find the document you need? Here's more info
Need to look up a microcircuit part number? Try our on-line Standard Microcircuit Cross-Reference
Want to be notified of proposed changes to Standard Microcircuit Drawings? Sign up to our SMD Registered Users List.

Please give us your feedback on any Mil Spec or Drawing issues.

Comments or questions: VaWebTeam@dla.mil

Figure 4. DLA parts search interface.



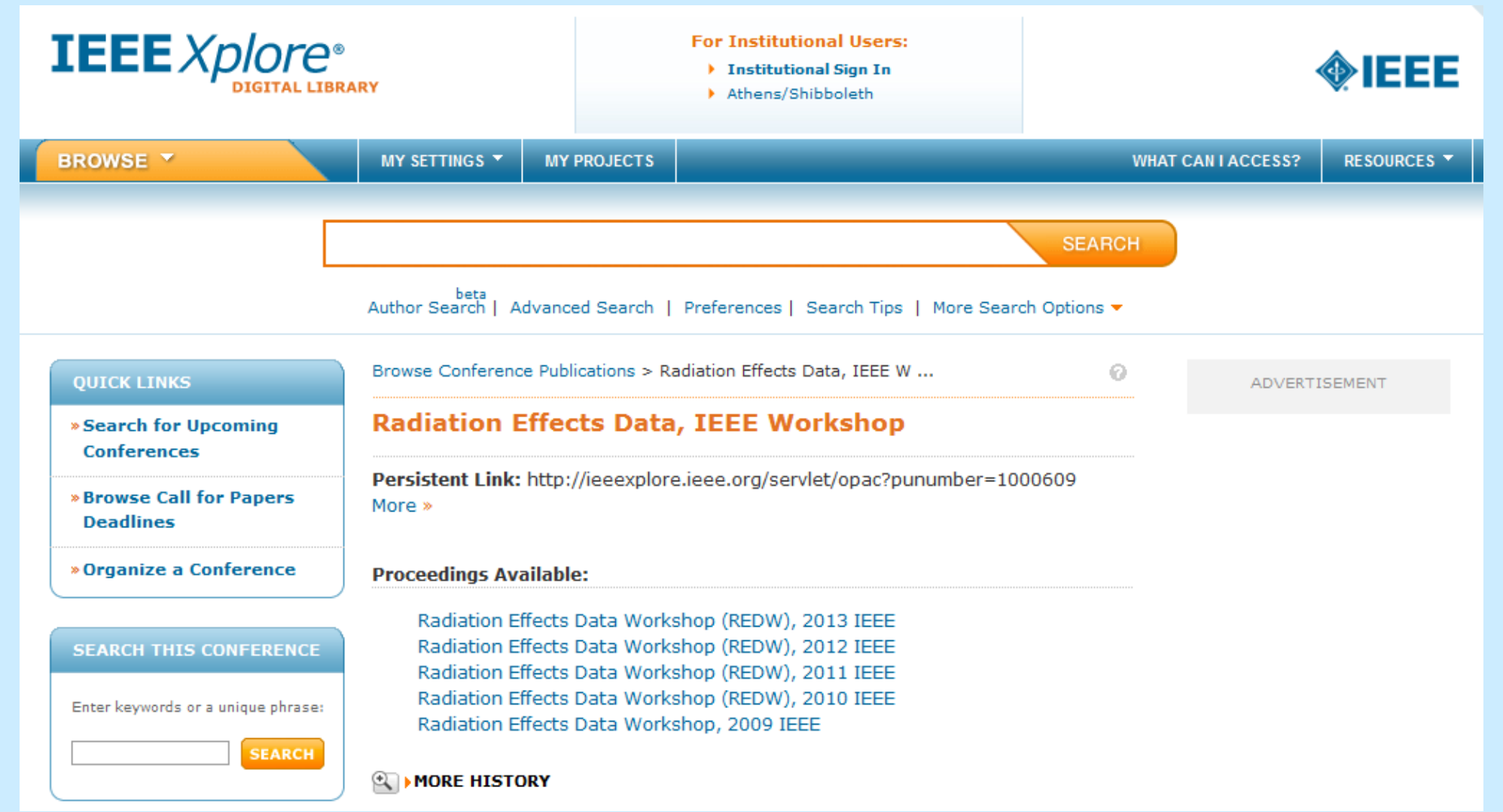
1.5 Radiation features

Maximum total dose available (dose rate = 3 rads(Si)/s) .... 50×10^3 rads(Si)
Single event phenomenon (SEP) effective
linear energy threshold (LET) with no upsets (devices 01 -04)........ ≥ 1 MeV-cm^2/mg 3/
with no latch-up (devices 01 -04)........ ≥ 80 MeV-cm^2/mg 3/
linear energy threshold (LET) with no upsets (devices 05 and 06)........ ≥ 2.8 MeV-cm^2/mg 4/
with no latch-up (devices 05 and 06)........ ≥ 110 MeV-cm^2/mg 4/

Figure 5. DLA radiation features for Aeroflex UT8Q512 512K X 8-bit rad-hard low voltage SRAM.[2]

IEEE Xplore Radiation Effects Data Workshop (REDW)

The IEEE Xplore REDW offers access to publications from 1992 to present. Figure 6 shows the IEEE Xplore REDW web interface.



Browse Conference Publications > Radiation Effects Data, IEEE W ...

Radiation Effects Data, IEEE Workshop

Persistent Link: http://ieeexplore.ieee.org/servlet/opac?punumber=1000609
More »

Proceedings Available:

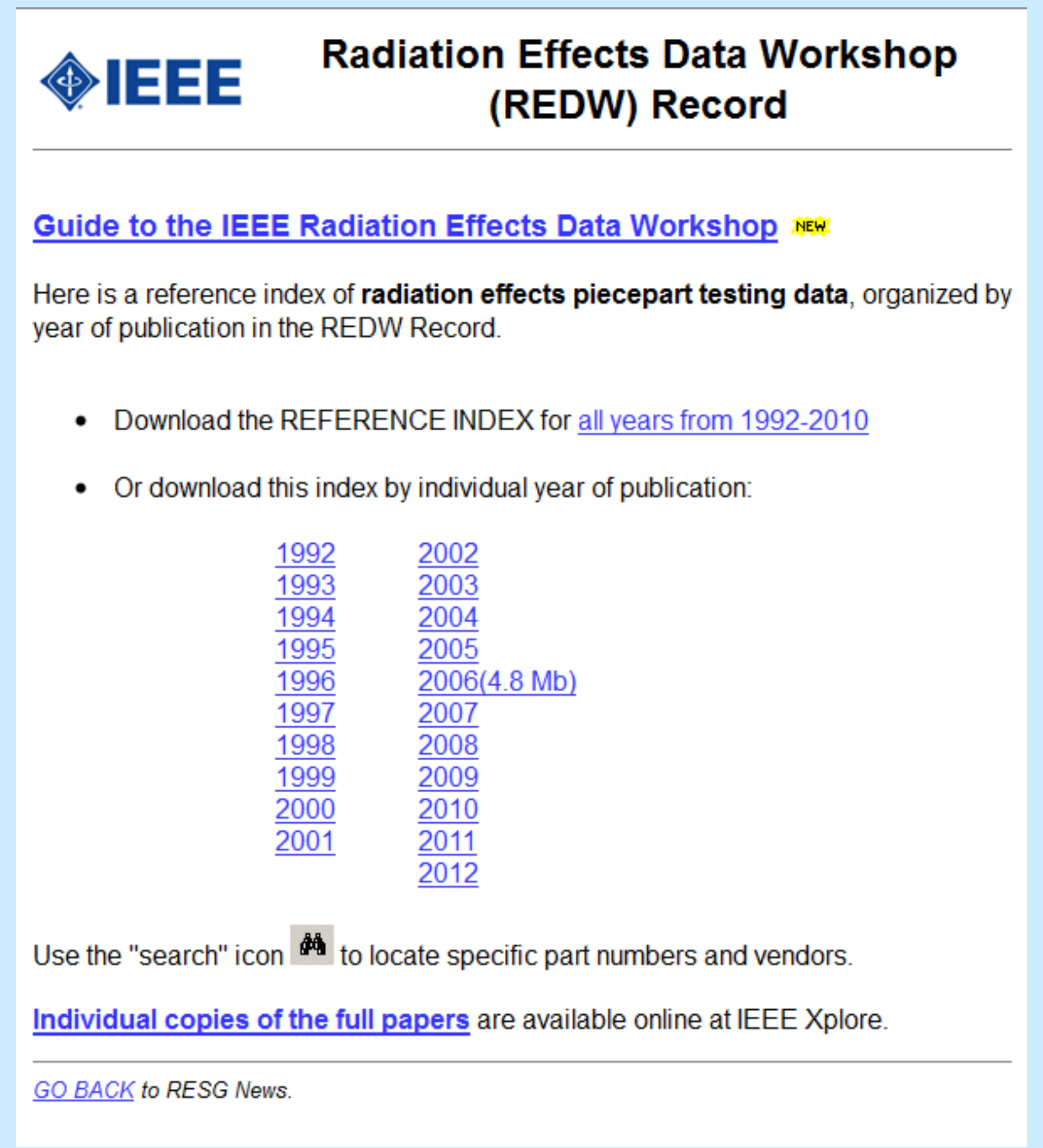
Radiation Effects Data Workshop (REDW), 2013 IEEE
Radiation Effects Data Workshop (REDW), 2012 IEEE
Radiation Effects Data Workshop (REDW), 2011 IEEE
Radiation Effects Data Workshop (REDW), 2010 IEEE
Radiation Effects Data Workshop, 2009 IEEE

Figure 6. IEEE Xplore Radiation Effects Data Workshop web interface.

IEEE Radiation Effects Data Workshop

The IEEE Radiation Effects Data Workshop (REDW) piece-part testing data, compiled by David Hiemstra, offers a detailed index to the test results published in REDW. Figure 7 shows the IEEE REDW piece-part testing data web interface.

The database shows REDW year, paper number and page(s), first author, part number, type, manufacture, as well as an indication of what types of testing were performed including: ELDERS, protons, electrons, SEU, SET, SEFIs, SEL, SEB, SEGR, dose rate, displacement damage, facilities, and shielding. Figure 8 shows a sample of data features.



Radiation Effects Data Workshop (REDW) Record

Guide to the IEEE Radiation Effects Data Workshop NEW

Here is a reference index of **radiation effects piecepart testing data**, organized by year of publication in the REDW Record.

- Download the REFERENCE INDEX for all years from 1992-2010
- Or download this index by individual year of publication:

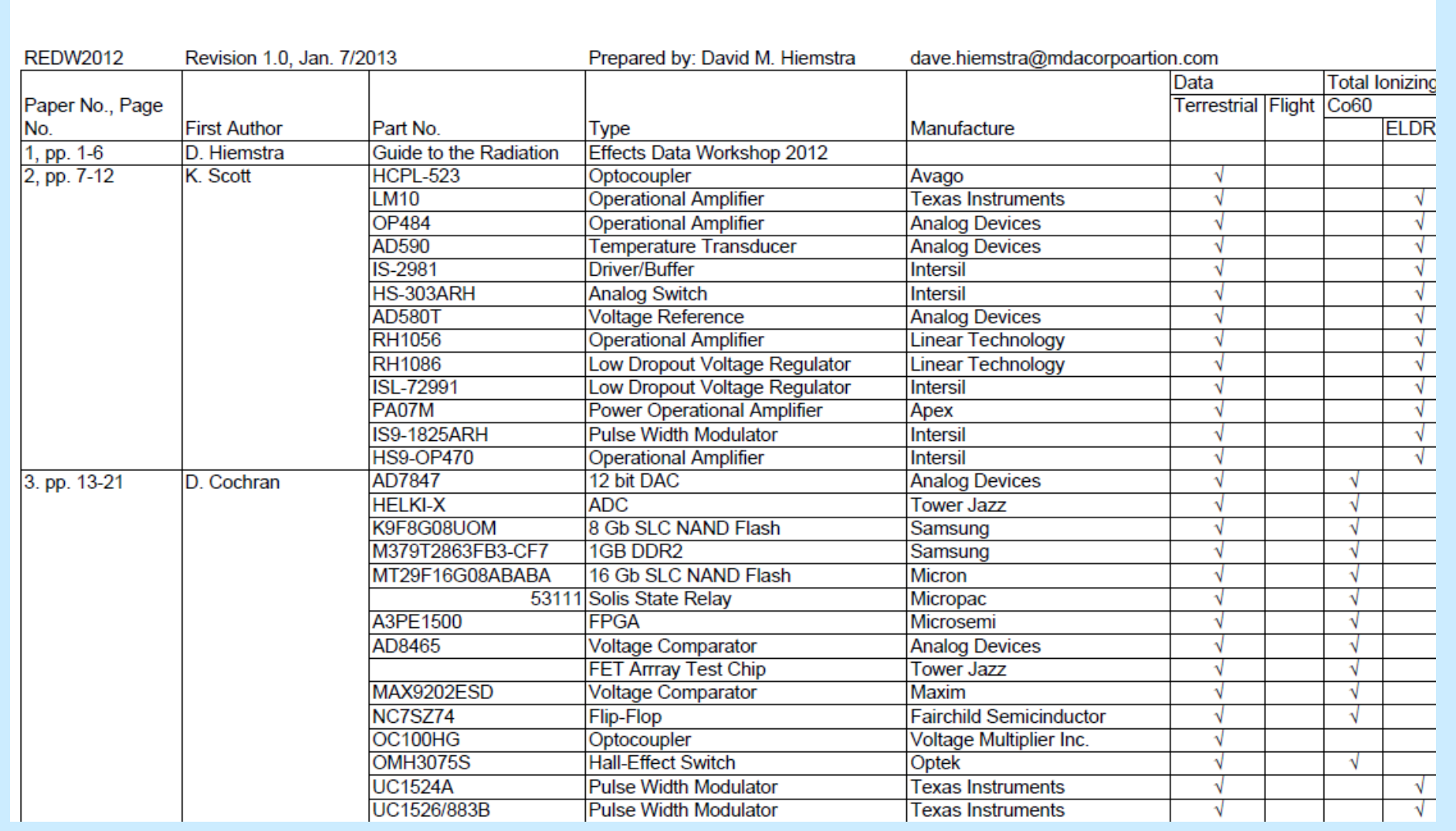
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006(4.8 Mb)
2007
2008
2009
2010
2011
2012

Use the "search" icon to locate specific part numbers and vendors.

Individual copies of the full papers are available online at IEEE Xplore.

GO BACK to RESG News.

Figure 7. IEEE REDW piece-part testing data web interface.



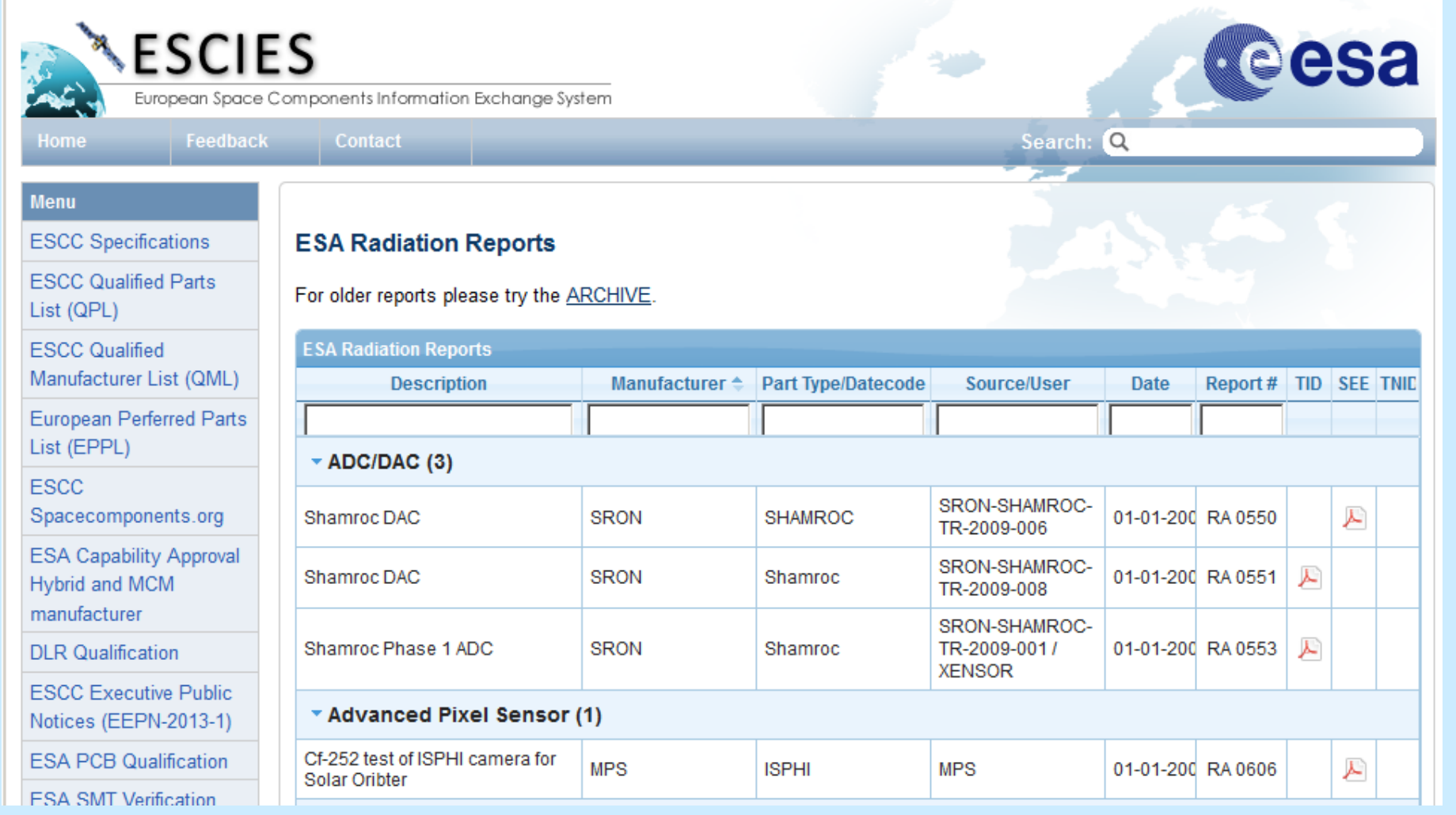
REDW2012   Revision 1.0, Jan. 7/2013   Prepared by: David M. Hiemstra   dave.hiemstra@mdacorpoartion.com

Paper No., Page No.	First Author	Part No.	Type	Manufacture	Data		Total Ionizing	
					Terrestrial	Flight	Co60	
								ELDR
1, pp. 1-6	D. Hiemstra	Guide to the Radiation	Effects Data Workshop 2012					
2, pp. 7-12	K. Scott	HCPL-523	Optocoupler	Avago	√			
		LM10	Operational Amplifier	Texas Instruments	√			√
		OP484	Operational Amplifier	Analog Devices	√			√
		AD590	Temperature Transducer	Analog Devices	√			√
		IS-2981	Driver/Buffer	Intersil	√			√
		HS-303ARH	Analog Switch	Intersil	√			√
		AD580T	Voltage Reference	Analog Devices	√			√
		RH1056	Operational Amplifier	Linear Technology	√			√
		RH1086	Low Dropout Voltage Regulator	Linear Technology	√			√
		ISL-72991	Low Dropout Voltage Regulator	Intersil	√			√
		PA07M	Power Operational Amplifier	Apex	√			√
		IS9-1825ARH	Pulse Width Modulator	Intersil	√			√
		HS9-OP470	Operational Amplifier	Intersil	√			√
3. pp. 13-21	D. Cochran	AD7847	12 bit DAC	Analog Devices	√		√	
		HELKI-X	ADC	Tower Jazz	√		√	
		K9F8G08UOM	8 Gb SLC NAND Flash	Samsung	√		√	
		M379T2863FB3-CF7	1GB DDR2	Samsung	√		√	
		MT29F16G08ABABA	16 Gb SLC NAND Flash	Micron	√		√	
		53111	Solis State Relay	Micropac	√		√	
		A3PE1500	FPGA	Microsemi	√		√	
		AD8465	Voltage Comparator	Analog Devices	√		√	
			FET Arrray Test Chip	Tower Jazz	√		√	
		MAX9202ESD	Voltage Comparator	Maxim	√		√	
		NC7SZ74	Flip-Flop	Fairchild Semiconductor	√		√	
		OC100HG	Optocoupler	Voltage Multiplier Inc.	√			
		OMH3075S	Hall-Effect Switch	Optek	√		√	
		UC1524A	Pulse Width Modulator	Texas Instruments	√			√
		UC1526/883B	Pulse Width Modulator	Texas Instruments	√			√

Figure 8. IEEE REDW piece-part testing data sample of database features.

European Space Components Information Exchange System

European Space Components Coordination (ESCC) European Space Components Information Exchange System offers many search options including description, manufacturer, part type/date code, source/user, data, report number, and links to TID, SEE, and displacement damage test reports. Figure 9 shows the European Space Components searchable web interface



ESA Radiation Reports

For older reports please try the ARCHIVE.

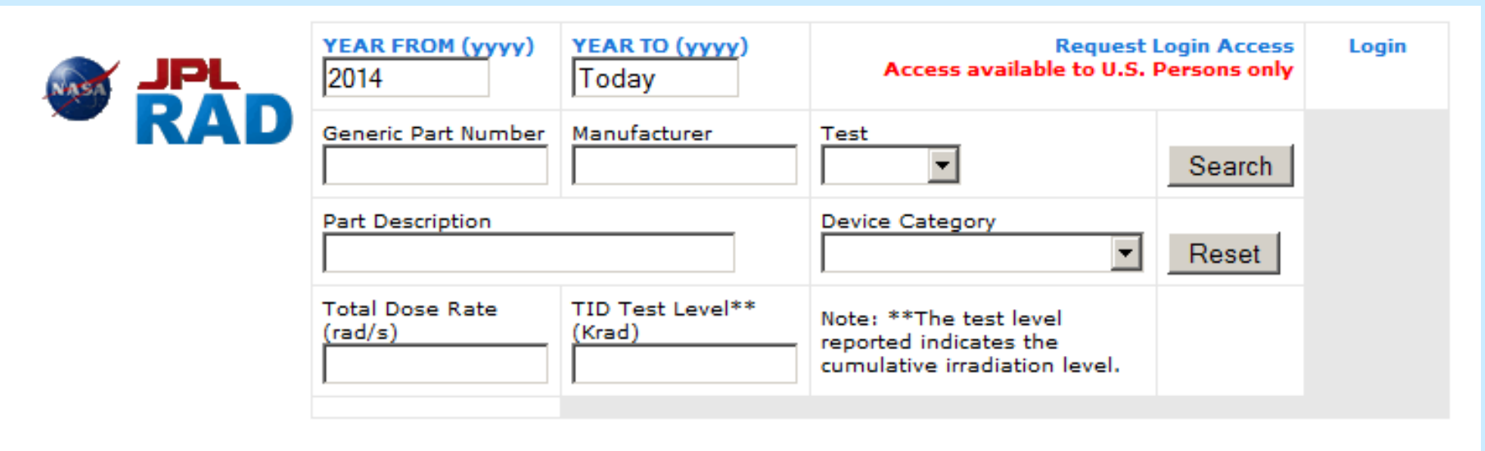
ESA Radiation Reports

Description	Manufacturer	Part Type/Datecode	Source/User	Date	Report #	TID	SEE	TNID
ADC/DAC (3)								
Shamroc DAC	SRON	SHAMROC	SRON-SHAMROC-TR-2009-006	01-01-200	RA 0550		▨	
Shamroc DAC	SRON	Shamroc	SRON-SHAMROC-TR-2009-008	01-01-200	RA 0551	▨		
Shamroc Phase 1 ADC	SRON	Shamroc	SRON-SHAMROC-TR-2009-001 / XENSOR	01-01-200	RA 0553	▨		
Advanced Pixel Sensor (1)								
Cf-252 test of ISPHI camera for Solar Oribter	MPS	ISPHI	MPS	01-01-200	RA 0606		▨	

Figure 9. European Space Components Information Exchange System web interface.

Jet Propulsion Laboratory

The Jet Propulsion Laboratory RAD Archive website data research interface is featured in Figure 10.



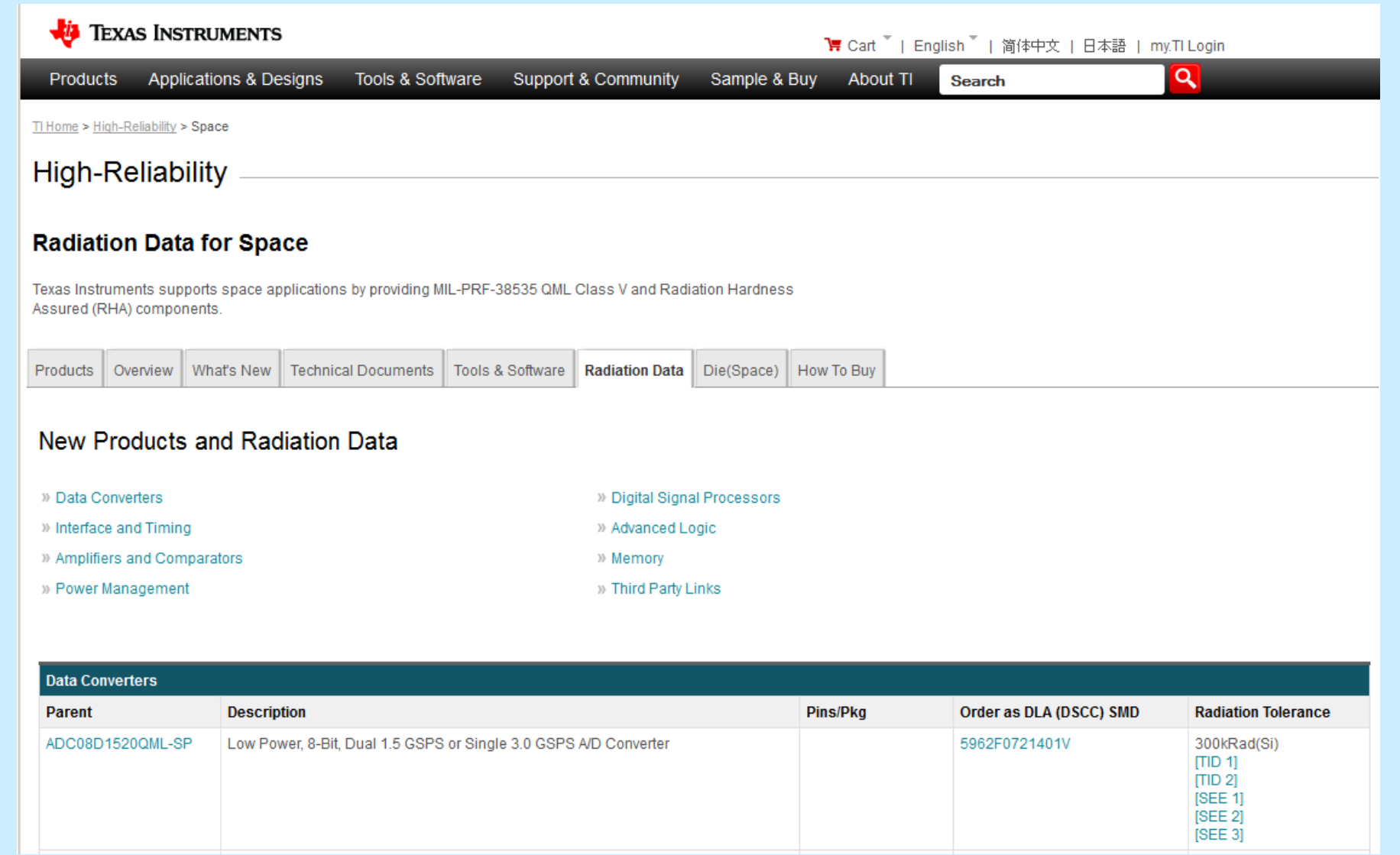
YEAR FROM (yyyy) 2014
YEAR TO (yyyy) Today
Generic Part Number
Manufacturer
Test ▾
Part Description
Device Category ▾
Total Dose Rate (rad/s)
TID Test Level** (Krad)

Note: **The test level reported indicates the cumulative irradiation level.

Figure 10. Jet Propulsion Laboratory RAD web interface.

Texas Instruments Radiation Data for Space

Texas Instruments Radiation Data for Space website data research interface is featured in Figure 11.



High-Reliability

Radiation Data for Space

Texas Instruments supports space applications by providing MIL-PRF-38535 QML Class V and Radiation Hardness Assured (RHA) components.

New Products and Radiation Data

» Data Converters
» Interface and Timing
» Amplifiers and Comparators
» Power Management
» Digital Signal Processors
» Advanced Logic
» Memory
» Third Party Links

Data Converters

Parent	Description	Pins/Pkg	Order as DLA (DSCC) SMD	Radiation Tolerance
ADC08D1520QML-SP	Low Power, 8-Bit, Dual 1.5 GSPS or Single 3.0 GSPS A/D Converter		5962F0721401V	300kRad(Si) [TID 1] [TID 2] [SEE 1] [SEE 2] [SEE 3]

Figure 11. Texas Instruments National Radiation Data for Space web interface.

Other Search Tools

Search Engines

Search engines such as Google can be useful for researching radiation test data. However, even with specific search keywords, there may still be the need to eliminate some unexpected results. Also, it is necessary to verify that the source is legitimate.

Cautions

Here are a few aspects to consider:

- The user should check with the manufacturer to determine whether any process changes have been made after independent party testing was performed.
- Test results may vary from lot to lot. We highly recommend that lot testing be performed on any suspect or commercial device.
- Some websites require a log-in account to access the radiation test data.

Acknowledgment

This work was supported in part by the NASA Electronic Parts and Packaging (NEPP) Program and the Defense Threat Reduction Agency (DTRA).

Summary

This poster is intended to be a resource for locating radiation test data. Knowing where to search for test results is a valuable resource for the aerospace engineer or spacecraft design engineer. However, realizing that information technology is always evolving, the resources listed in this poster should always be augmented with current research methods. The authors of this poster welcome updates and suggestions for additional radiation test data resources.

References

[1] K. A. LaBel, L. M. Cohn, and R. L. Ladbury, "Are Current SEE Test Procedures Adequate for Modern Devices and Electronics Technologies?," http://radhome.gsfc.nasa.gov/radhome/papers/ HEART08_LaBel.pdf.

[2] Defense Logistics Agency (DLA) Land and Maritime Specifications for Aeroflex UT8Q512 512K X 8-bit rad-hard low voltage SRAM, http://www.landandmaritime.dla.mil/ Downloads/MilSpec/Smd/99607.pdf

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