HIREX ENGINEERING®

Radiation Evaluation of Commercial Off-The-Shelf (COTS) - Support IC's for Data Handling Applications

Contract N° 13528/99/NL/MV, COO-2

D/TOS-QCA Final Presentation Day, January 30th 2001

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Evaluation Content

- Parts Selection
- Total Ionizing Dose
- Single Event Effects

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Outline Presentation

- Tested Products
- Total Ionizing Dose
- Single Event Effects

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Tested Products

- New generation Logic families
- Linear : Amplifiers (hirel samples)
- Linear : Analog Switches (hirel samples)

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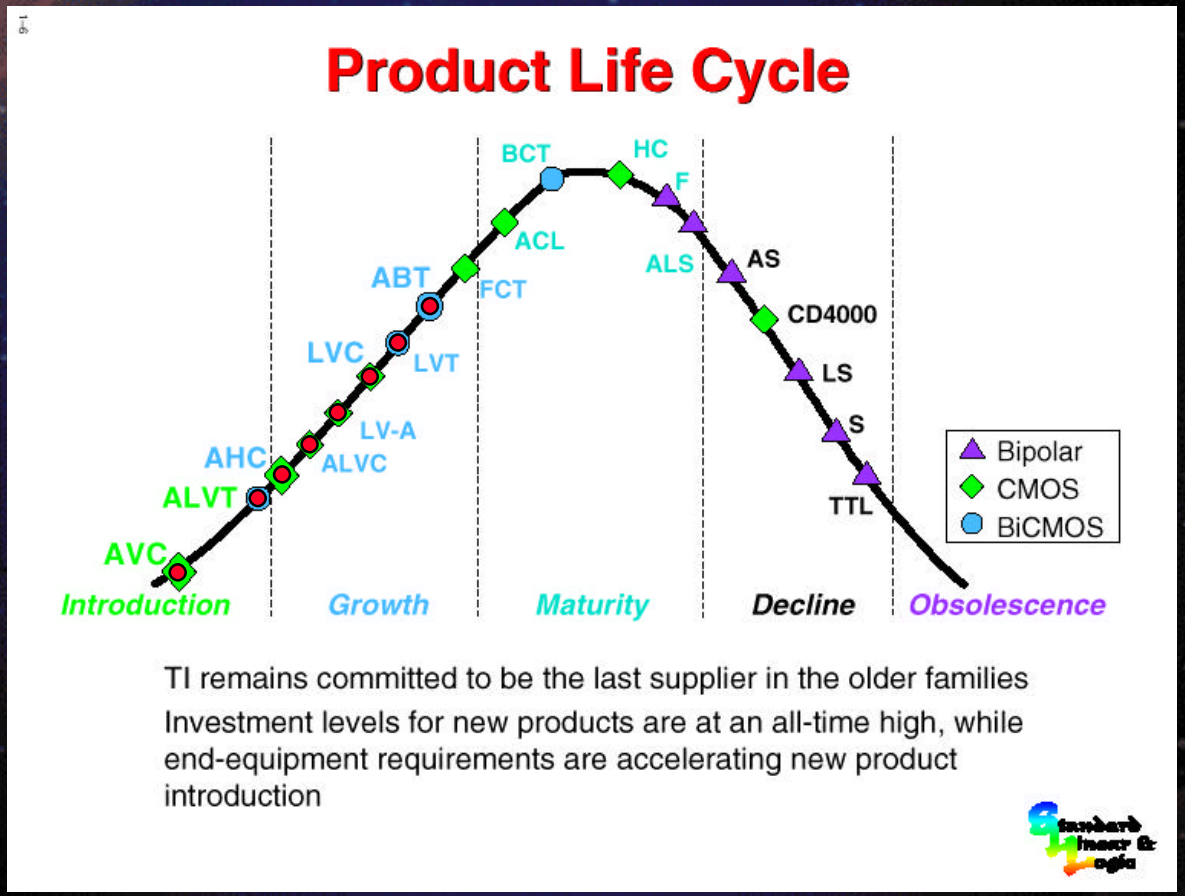
Tested Products : Logic families



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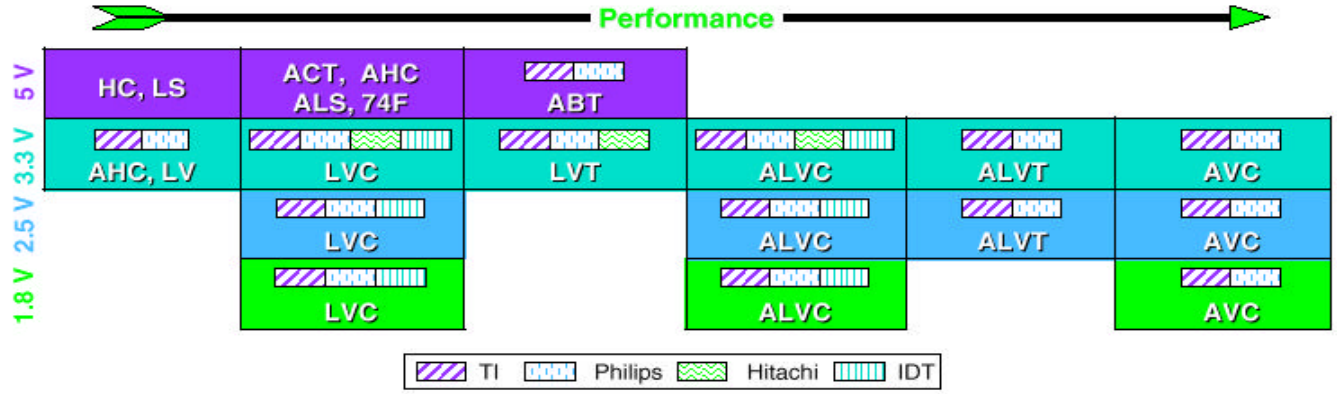
Tested Products : Logic families

Complete Low-Voltage Market Coverage and Standardization



AHC
- ✓8.5ns speed (5V)
- ✓13.5ns speed (3.3V)
- ✓-8/8mA drive (5V)
- ✓-4/4mA drive (3.3V)
- ✓5V or 3.3V V_{CC}
- ✓5V input tolerant
- ✓4 WW sources

LVC
- 6.5ns speed
- -24/24mA drive
- Ultra-low (20µA) standby power
- 3 WW sources
- Bus hold
- 5V tolerant
- Gate functions
- Live insertion

LVT
- ✓4ns speed
- ✓-32/64mA drive
- ✓Low (90µA) standby power
- ✓3 WW sources
- ✓Bus hold
- ✓5V tolerant
- ✓Live insertion

ALVC
- ✓3ns speed
- ✓-24/24mA drive
- ✓Ultra-low (40µA) standby power
- ✓3 WW sources
- ✓Bus hold

ALVT
- ✓2.4ns speed
- ✓-32/64mA drive
- ✓Low (90µA) standby power
- ✓2 WW sources
- ✓Bus hold
- ✓5V tolerant
- ✓Live insertion
- ✓Auto 3-state

AVC
- ✓< 2ns speed
- ✓-12/12mA drive
- ✓Ultra-low (40µA) standby power
- ✓2 WW sources
- ✓Bus hold
- ✓3.3V tolerant
- ✓Live insertion

1-25

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Total Ionizing Dose Evaluation

- Octal/16-Bit Bus Transceivers (245 Types)
- Octal D-Type Flip-Flops (374 Types)

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TID Tested Products: Logic devices

Family	Manufacturer	Type
Low Voltage (LV)	Texas Instruments	74LV374A
	Texas Instruments	74LV245A
	Philips	74LV245D
Advanced Low Voltage CMOS (ALVCH)	Texas Instruments	74ALVCH16374
	Philips	74ALVCH16245A
Advanced BiCMOS Technology (ABT)	Texas Instruments	74ABT374A
	Texas Instruments	74ABT245B
Advanced High-Speed CMOS (AHC)	Texas Instruments	74AHC374
	Texas Instruments	74AHC245
Advanced CMOS (AVC)	Texas Instruments	74AVC16374
	Texas Instruments	74AVC16245
Advanced Low Voltage TTL (ALVTH)	Texas Instruments	74ALVTH16374
Low Voltage CMOS (LVCH)	Texas Instruments	74LVCH16245A

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TID Tested Electrical Parameters

- Input, Output Leakage currents (Iil, Iih, Iozl, Iozh), Output Voltages (Voh, Vol), Supply currents (Dynamic, Static)
- AC Electrical Parameters (tsu, thold, tplh, tphl, tpzh, tphz)
- Functional test @ 150MHz

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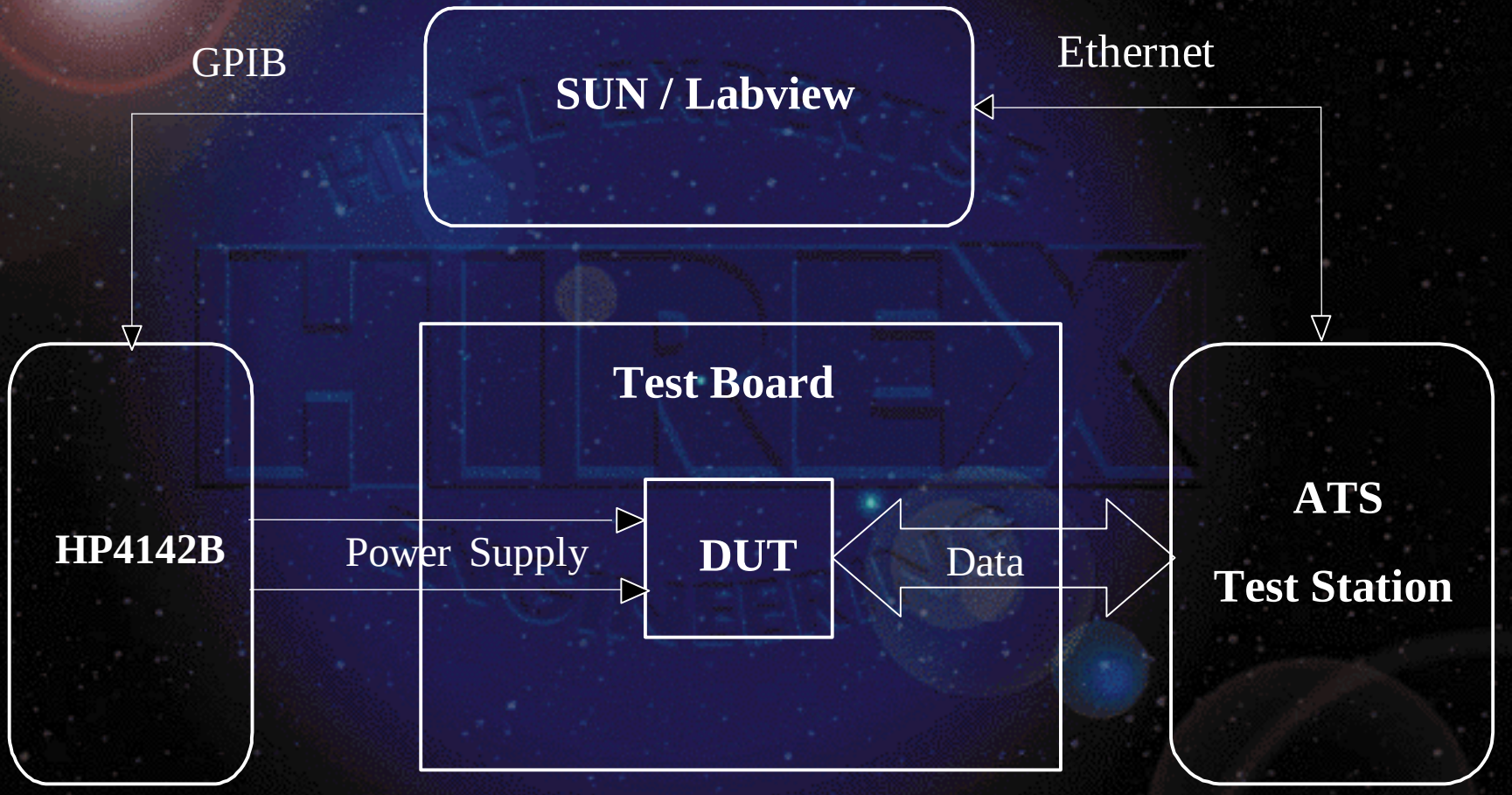
TID Test Programs Principle



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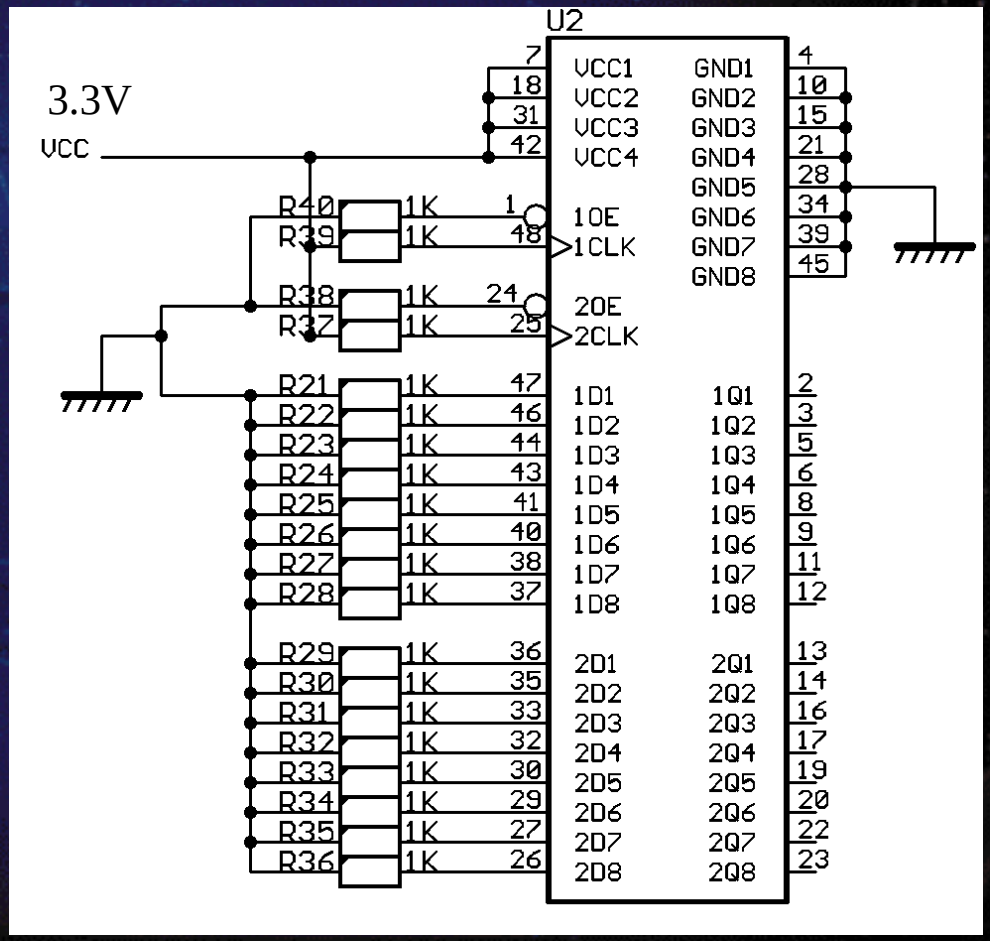
TID Bias Conditions (245 Types)

74AVC16245



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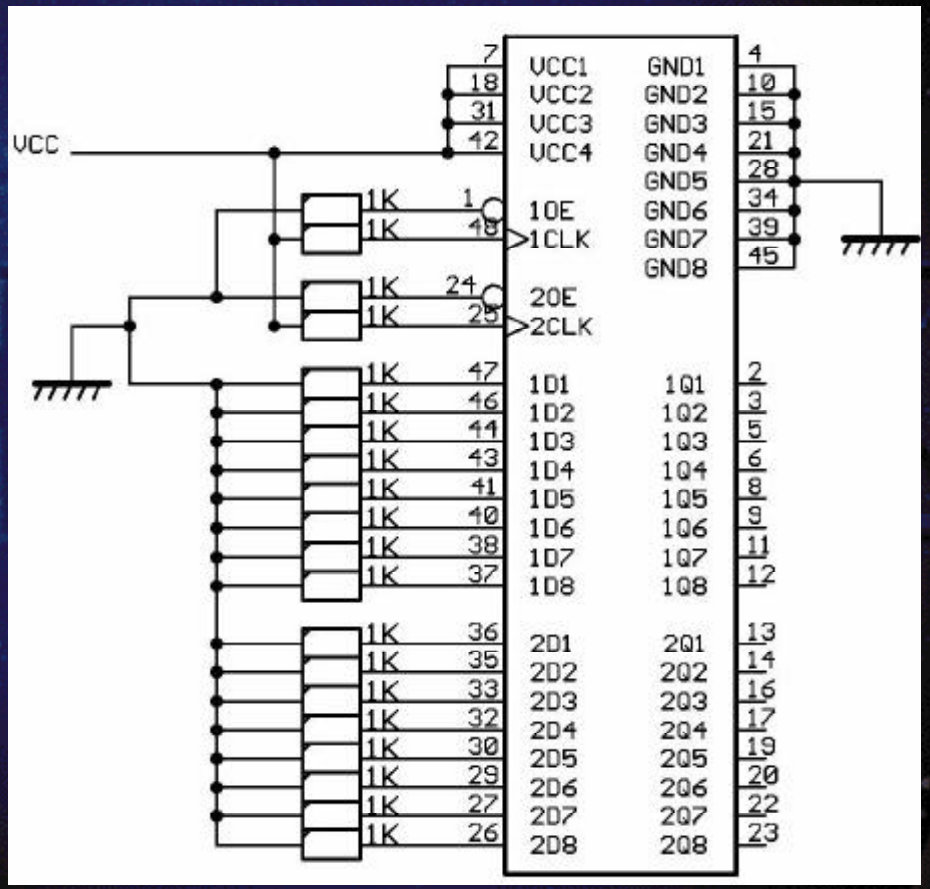
TID Bias Conditions (374 Types)

74AVC16374

3.3V



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TID Tests Conditions

- 5 Samples per type tested
- Dose rates: 180 and 230 rad(Si)/hour
- Irradiation and testing at room temperature
- CO60 Exposures at ONERA up to 50 Krad(Si) in 5 steps
- Annealing: 24H at 25°C & 168H at 100°C

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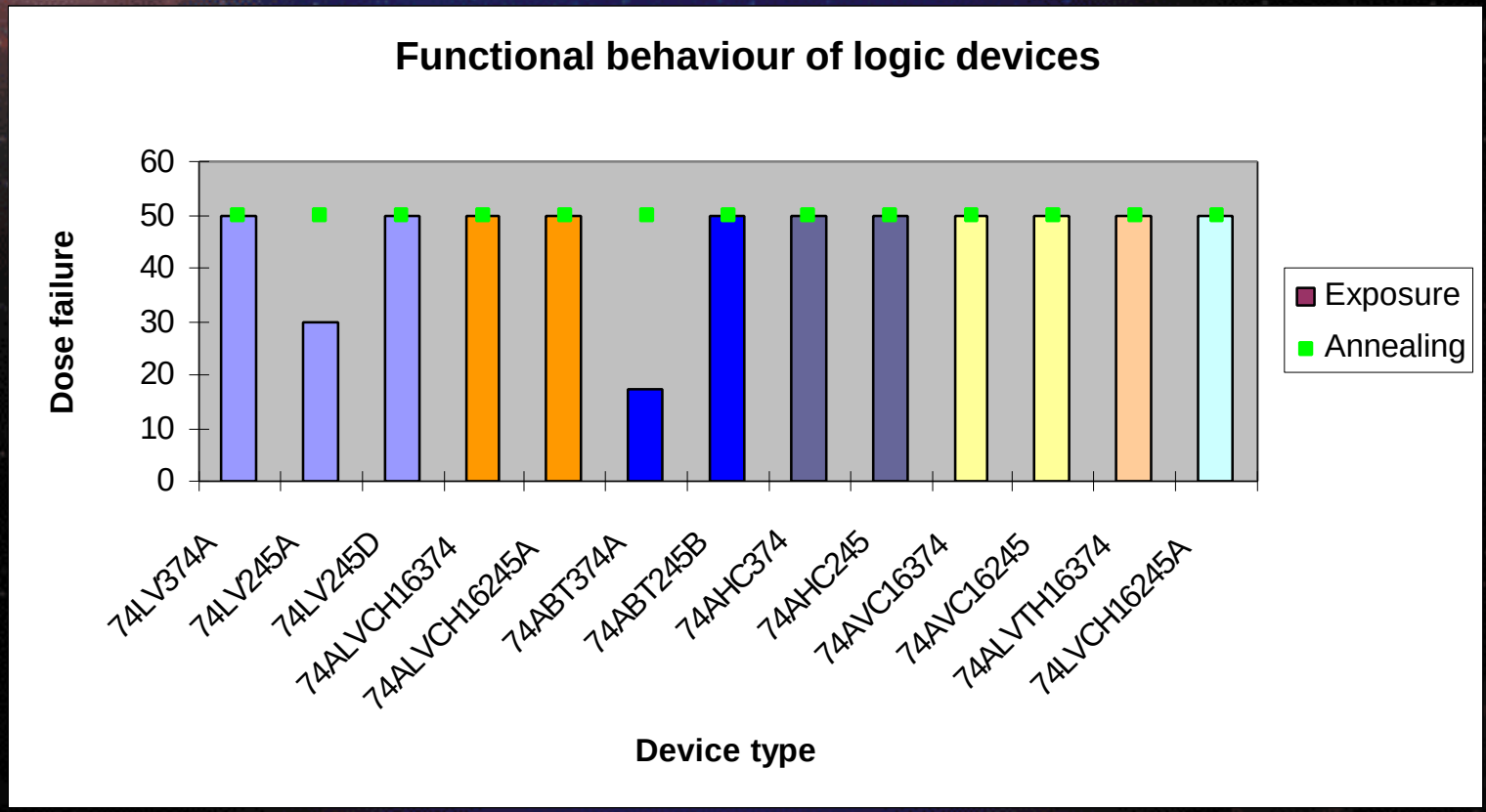
TID Test Results: Functional



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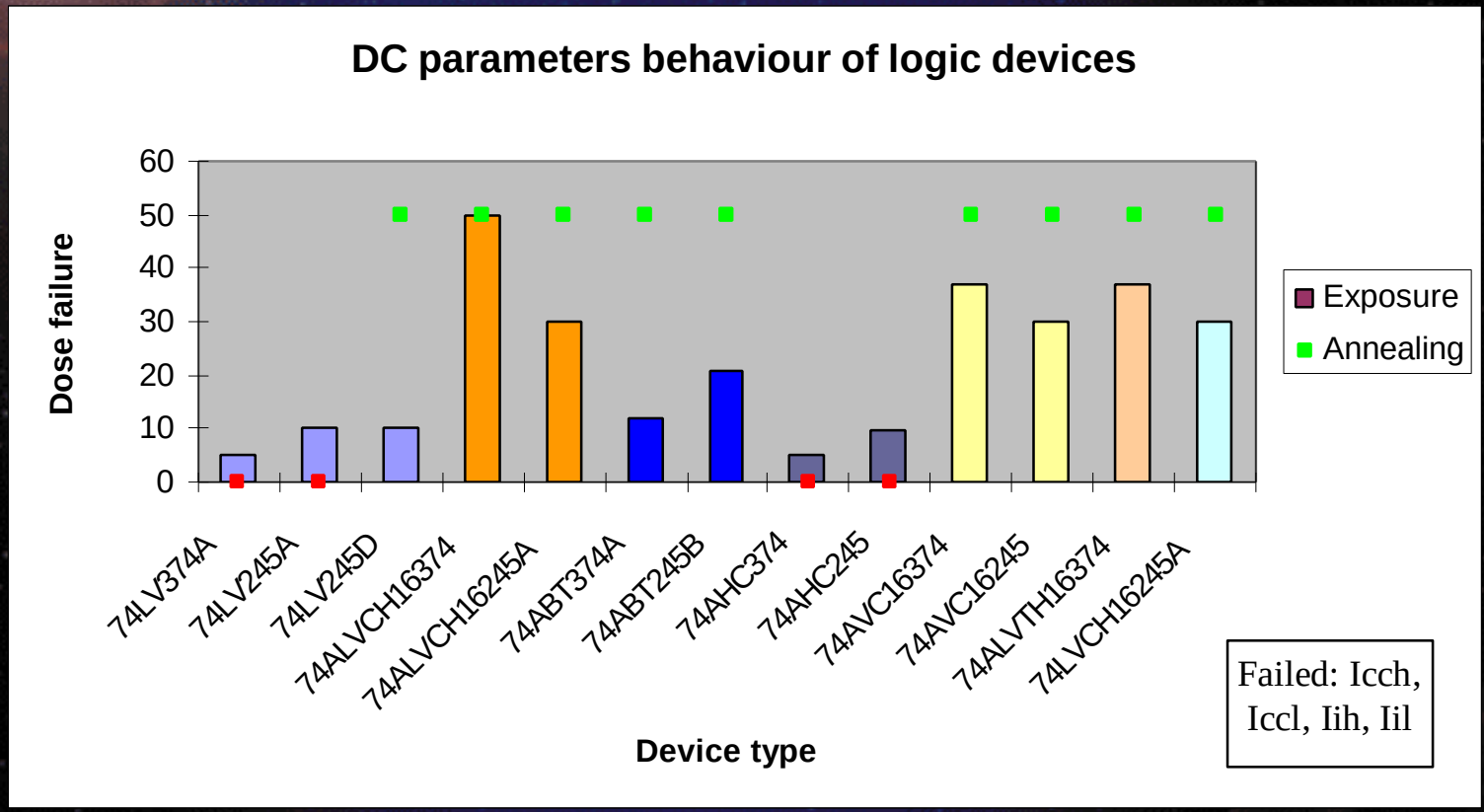
TID Test Results: DC parameters



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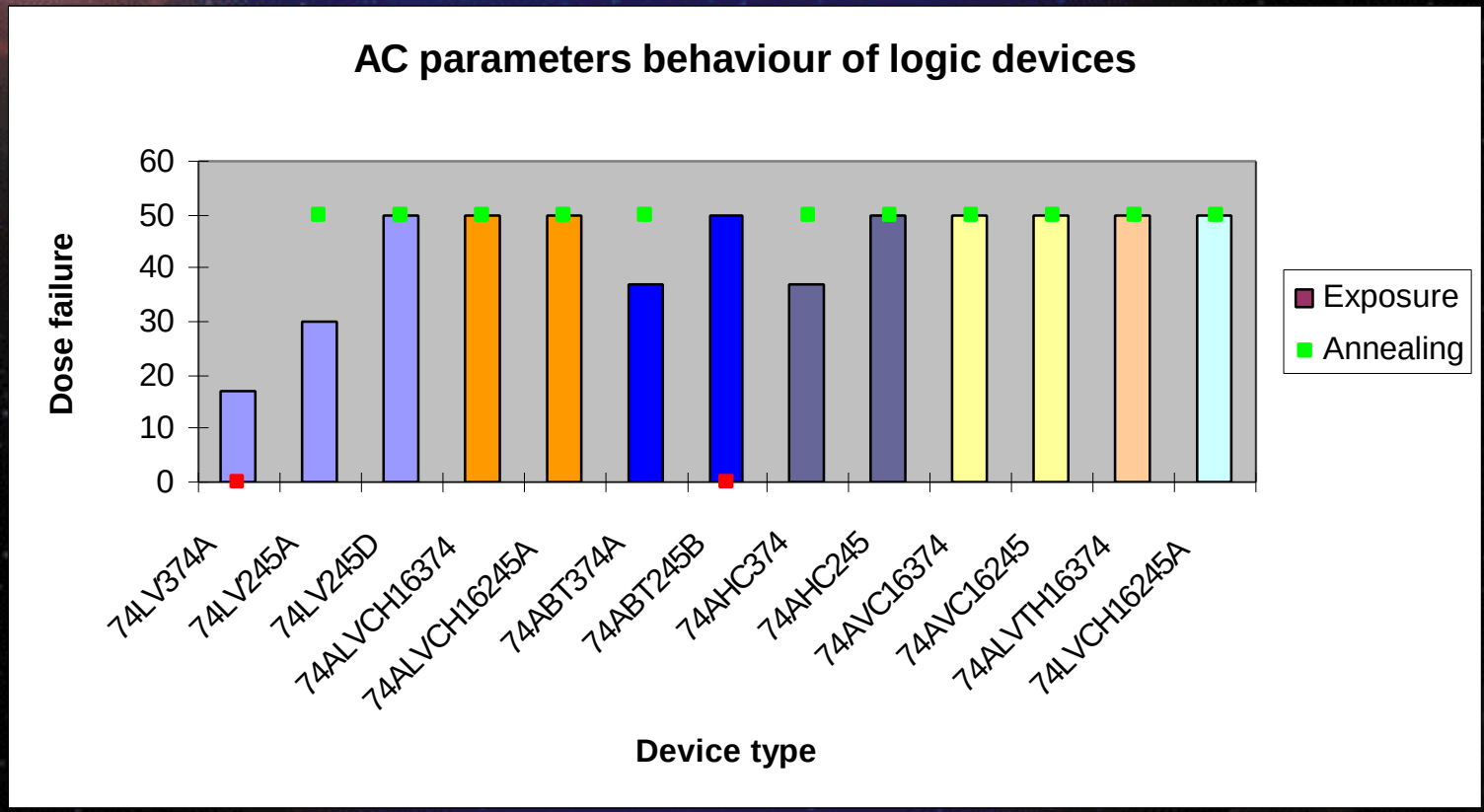
TID Test Results: AC parameters



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Single Event Effect

- Logic families, 245 and 374 (commercial)
- Amplifiers (hirel samples)
- Analog Switches (hirel samples)

Test performed 1st Quarter 2000,
at the European Heavy Ion Facility (HIF),
Université catholique de Louvain, (Belgium)

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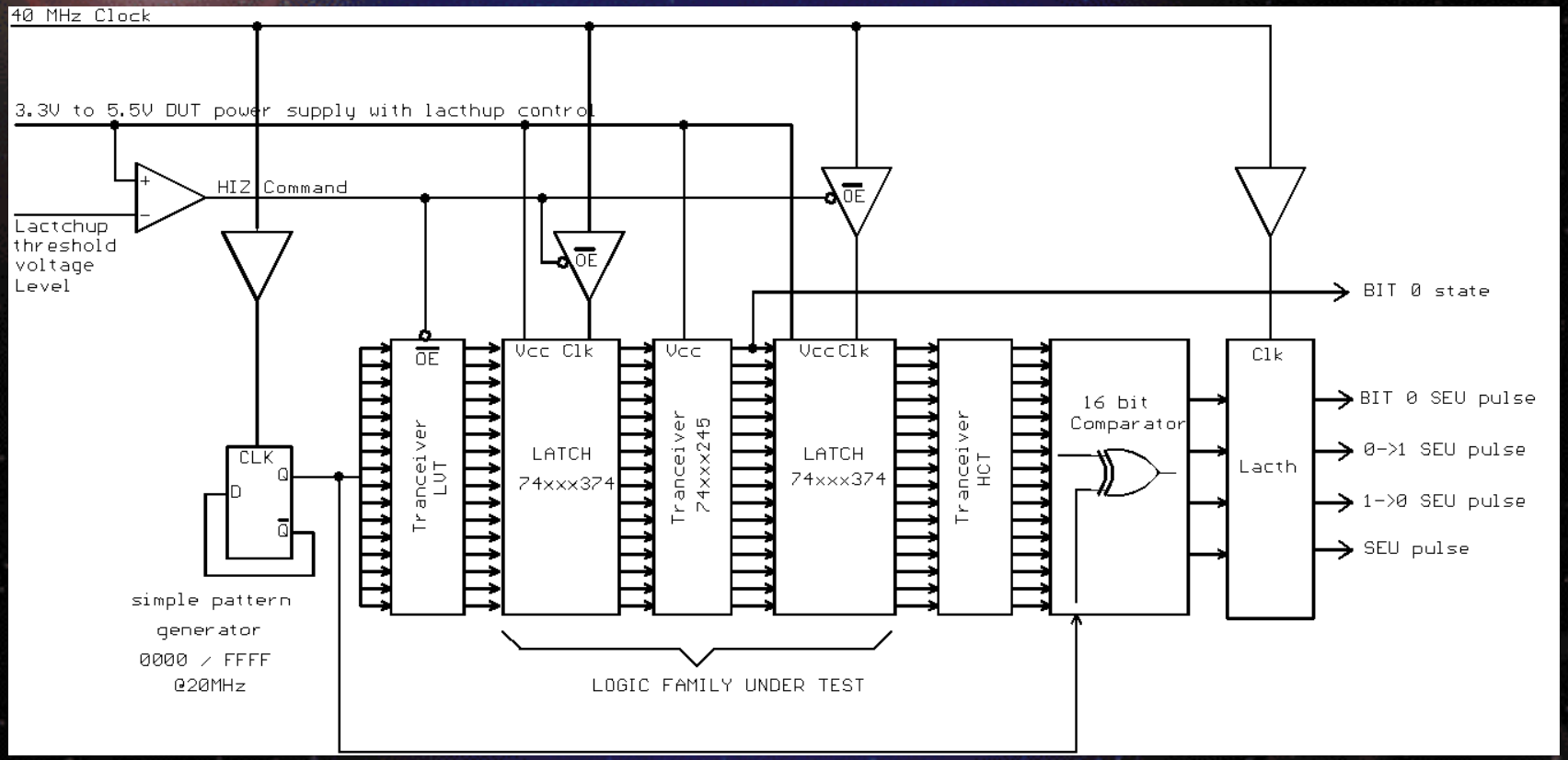
Logic Test Principle



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Results on Logic families

- Single Event Latch-up
  - 13 part types tested (245 and 374)
  - Only 74ALVTH16374 experienced SEL with Xenon @ 45 and 60 deg.
    LET ≥ 80MeV/(mg/cm²)
  - No latchup with Xenon @ 0 deg.
    LET =56 MeV/(mg/cm²)

Results on Logic families

- SEU results on transceivers (245)
  LET max 112 MeV/(mg/cm²), 1 E6 p/cm²

Part Type		DUT bias voltage			
		1V8	2V5	3V3	5V
74LV245A	Texas Instruments	-	0	0	0
74LV245D	Philips	-	1	2	0
74ALVCH16245A	Philips	-	0	0	-
74ABT245B	Texas Instruments	-	-	-	0
74AHC245	Texas Instruments	-	0	0	0
74AVC16245	Texas Instruments	-	0	0	-
74LVCH16245A	Texas Instruments	0	0	-	-

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Results on Logic families

74LV374A

SEU error cross-section per cell (cm^2)

Fluence 1 E6 p/cm^2

Beam			DUT Bias Voltage		
			2V5	3V3	5V
Ion	Angle	Effective LET			
84-Krypton	0	34	-	3.7 E-7	-
	60	68	-	7.4 E-7	-
132-Xenon	0	55.9	5 E-7	9 E-7	3.8 E-7
	45	79.1	-	9.4 E-7	-
	60	112	7.5 E-7	1.5 E-6	6.3 E-7

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Results on Logic families

- 74ABT374A
  SEU error cross-section per cell (cm²)
  Fluence 1 E6 p/cm²

Beam			DUT Bias Voltage		
			2V5	3V3	5V
Ion	Angle	Effective LET			
132-Xenon	0	55.9	-	-	3.2 E-7
	45	79.1	-	-	8.6 E-7
	60	112	-	-	1.39 E-6

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Results on Logic families

- 74AHC374A
  SEU error cross-section per cell (cm²)
  Fluence 1 E6 p/cm²

Beam			DUT Bias Voltage		
			2V5	3V3	5V
Ion	Angle	Effective LET			
132-Xenon	0	55.9	3.4 E-6	2.9 E-6	1.5 E-6
	45	79.1	-	2.9 E-6	
	60	112	4.5 E-6	3.4 E-6	2.9 E-6

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Results on Logic families

- 74AVC16374A
  SEU error cross-section per cell (cm²)
  Fluence 1 E6 p/cm²

Beam			DUT Bias Voltage		
			1V8	3V3	5V
Ion	Angle	Effective LET			
84-Krypton	60	68	-	<6.25 E-8	-
132-Xenon	60	112	<6.25 E-8	<6.25 E-8	-

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Results on Logic families

74ALVCH16374A
SEU error cross-section per cell (cm^2)
Fluence 1 E6 p/cm^2

Beam			DUT Bias Voltage		
			1V8	3V3	5V
Ion	Angle	Effective LET			
132-Xenon	0	55.9	5.6 E-7	<6.25 E-8	-
	45	79.1	-	6.25 E-8	-
	60	112	-	2.5 E-7	-

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Results on Logic families

74ALVTH16374A
SEU error cross-section per cell (cm^2)
Fluence 1 E6 p/cm^2

Beam			DUT Bias Voltage		
			2V5	3V3	5V
Ion	Angle	Effective LET			
84-Krypton	60	68	-	3.1 E-7	-
132-Xenon	0	55.9	-	6.25 E-8	-
	45	79.1	-	Note 1	-
	60	112	1.1 E-6	Note 1	-

Note1: SEL occurences

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Amplifiers Products

- Operational Amplifier Analog Devices
  - OP37
  - OP16 JFET-Input
  - OP42 JFET-Input
- Instrumentation Amplifier Analog Devices
  - AMP01

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OP AMPLIFIER SEE TEST

- Bias conditions
  - 0V differential voltage
  - Adjustable common voltage
  - Gain amplifier set to 100
- Transient detection at the amplifier output
  - Small threshold 5mV
  - Medium threshold 500mV
  - Large threshold 5V

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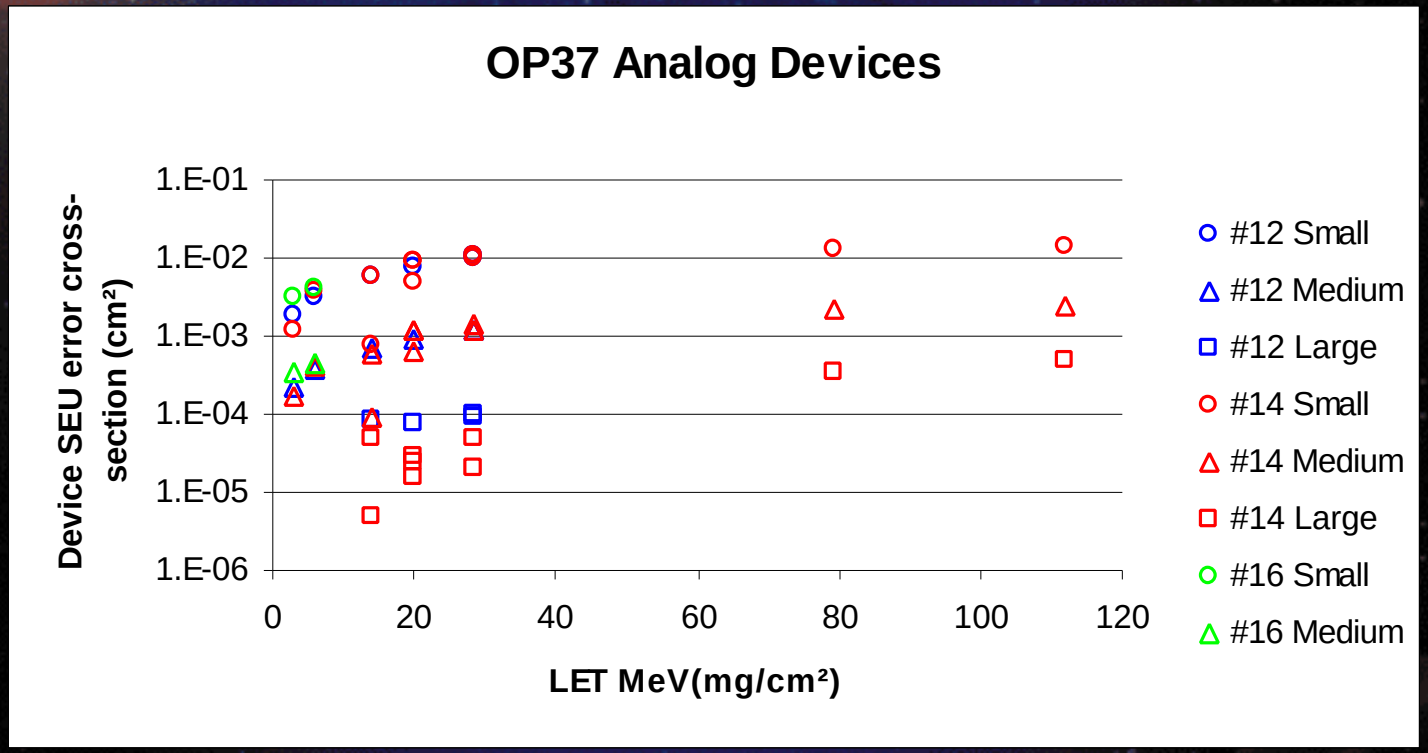
OP37 SEE RESULTS



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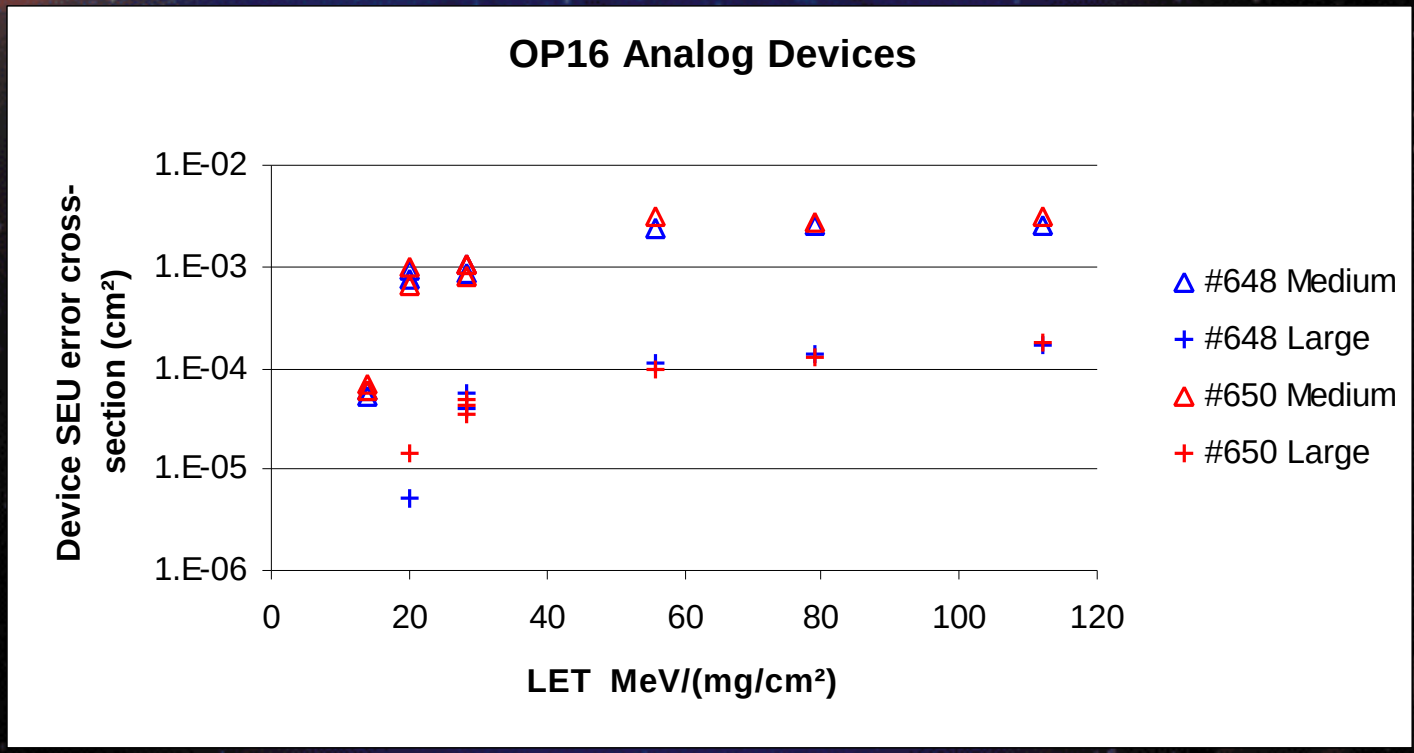
OP16 SEE RESULTS



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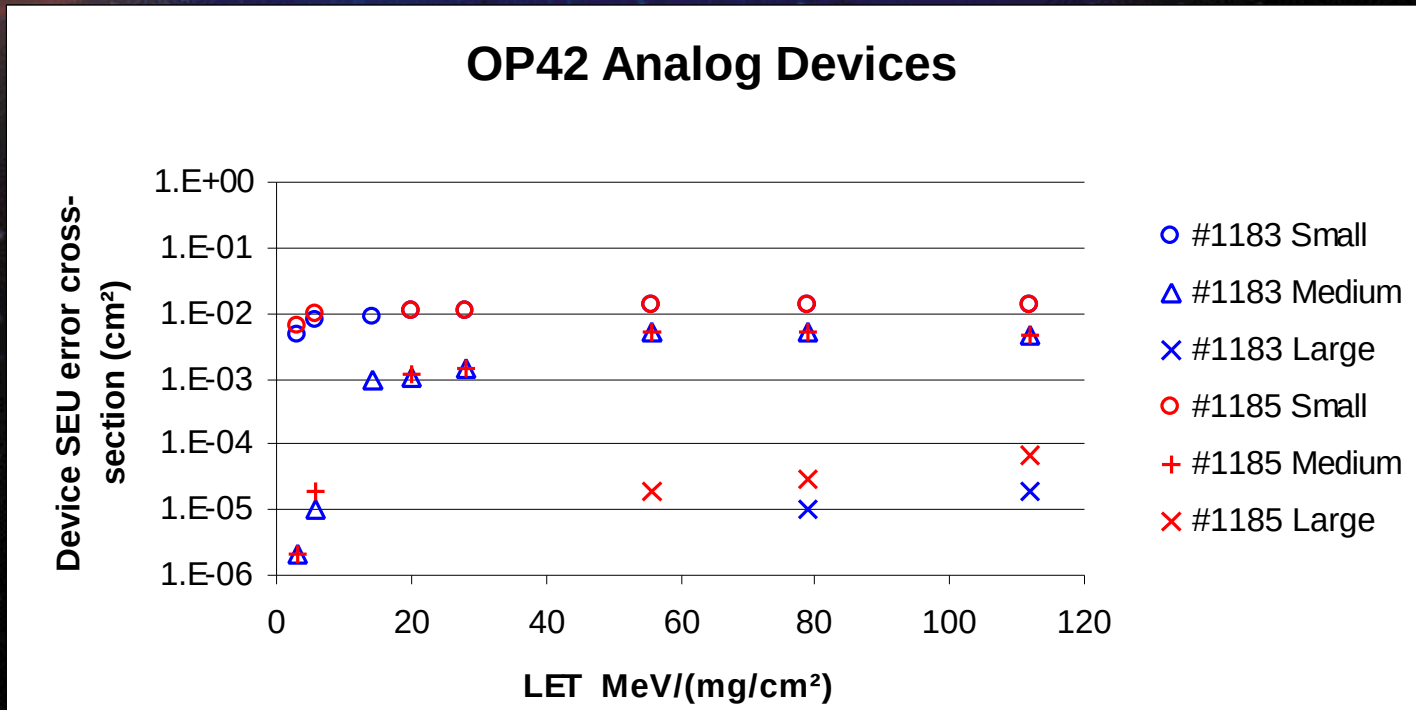
OP42 SEE RESULTS



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INSTR. AMP. SEE TEST

- Bias conditions
  - •Both inputs to ground
  - •Gain amplifier set to 90
- Transient detection at the amplifier output
  - •Small threshold 5mV
  - •Medium threshold 500mV
  - •Large threshold 5V

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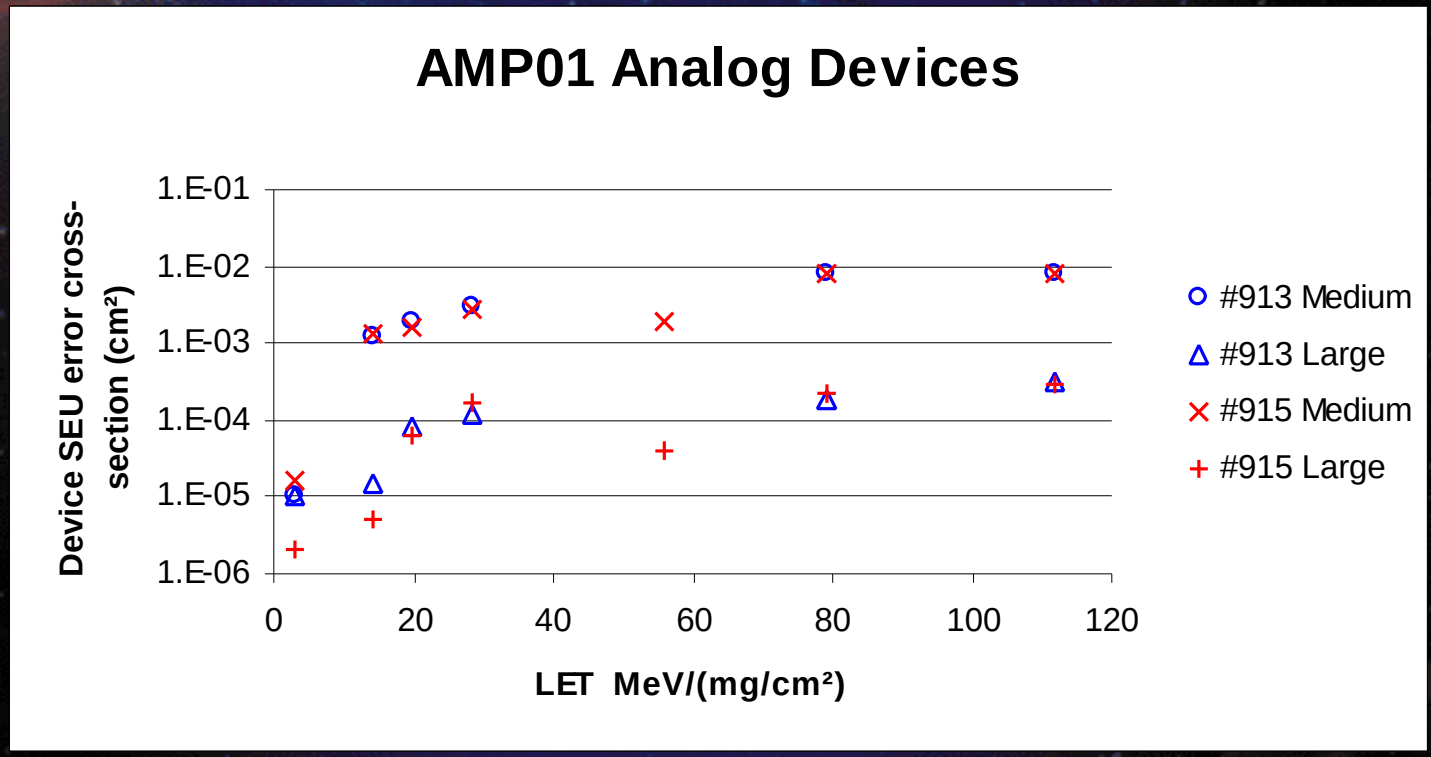
AMP01 SEE RESULTS



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Analog Switches Products

- SW201 Quad SPST JFET Analog Devices
- HS303RH Dual SPDT CMOS Harris

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SWITCH SEE TEST

- Bias conditions
  - •SW1 & SW2 Closed
  - •SW3 & SW4 Open
  - •Outputs connected to a resistor divider
- Transient detection
  - •Comparison between a reference resistor divider (650mV) and the resistor divider connected to the DUT outputs

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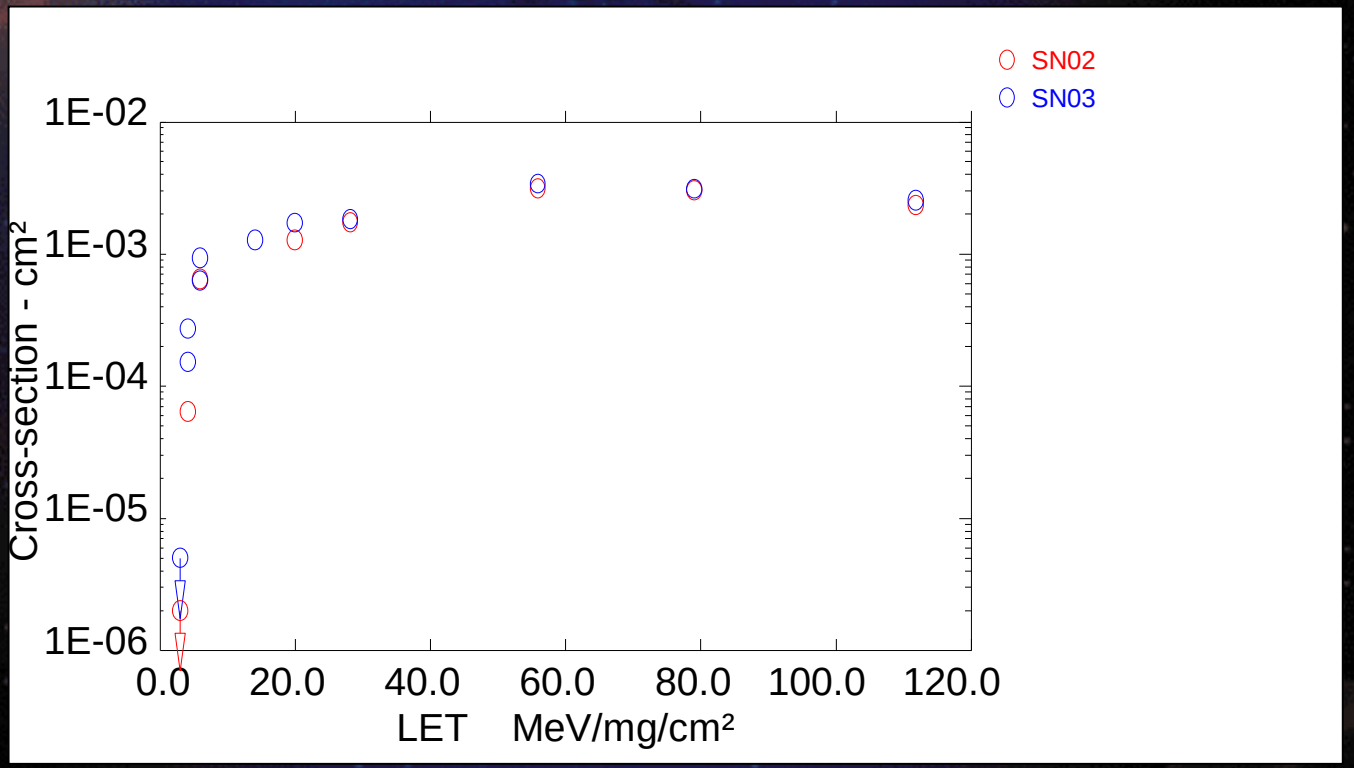
HS-303RH SEE RESULTS



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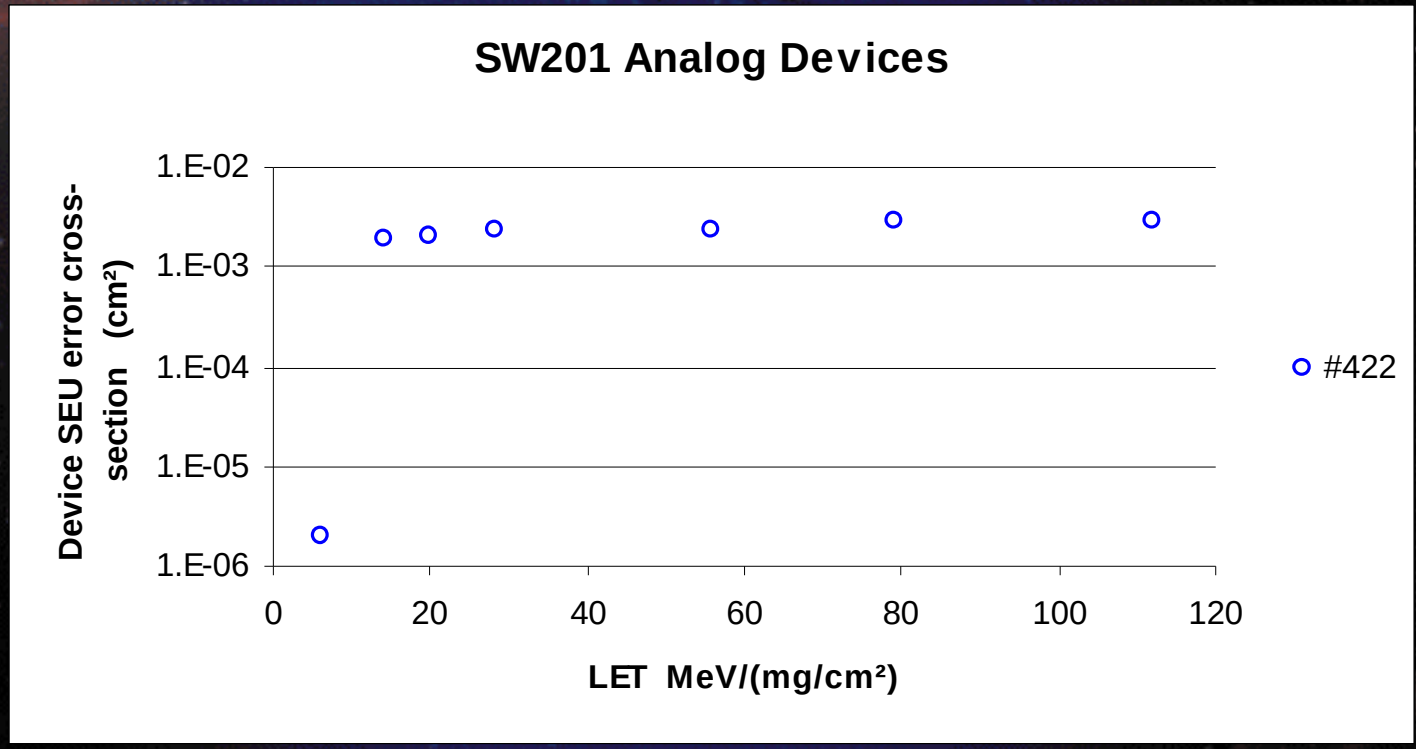
SW201 SEE RESULTS



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