



6th D/TOS-QCA Final Presentation Day 2004

Radiation Evaluation of 16-Bit Analog-to-Digital Converters:

Texas Instruments ADS8402, Analog Devices AD7677 and AD9260

ESTEC Contract No. 13528/99/NL/MV, COO-15

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Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Work performed under this contract:

- Procurement 50 parts per type
- Heavy ions Evaluation
- Electrical Characterization
- Total Dose Evaluation

ADS8402

Texas Instruments

AD7677

Analog Devices

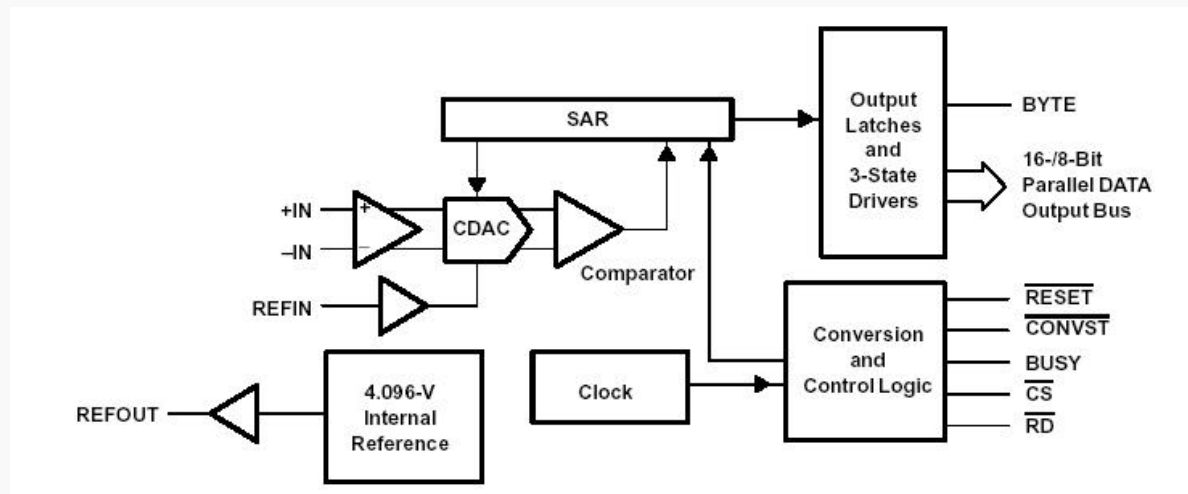
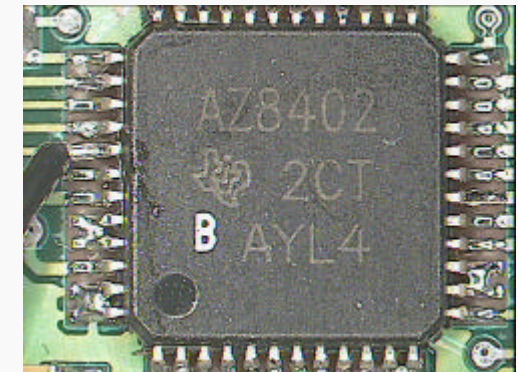
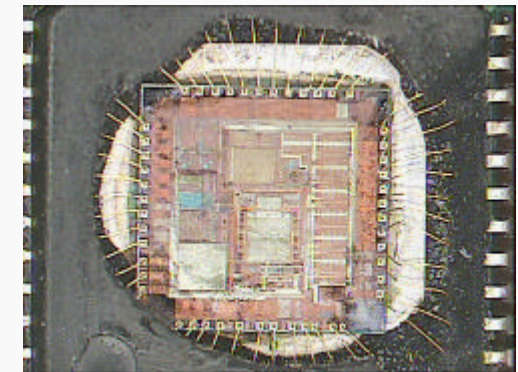
AD9260

Analog Devices

Radiation Evaluation of 16-Bit Analog-to-Digital Converters

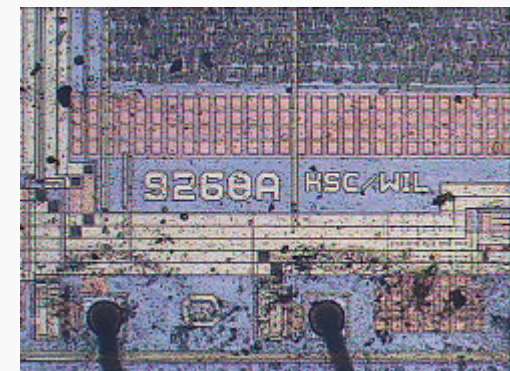
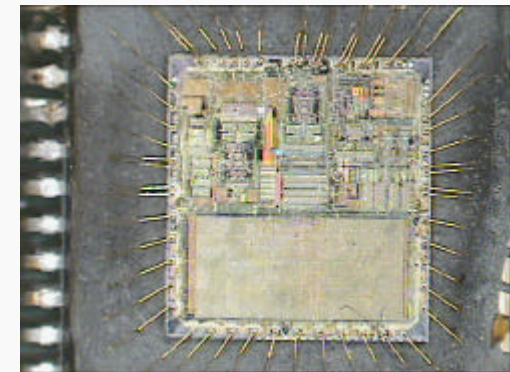
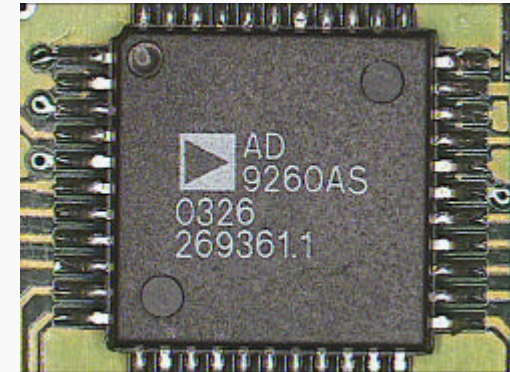
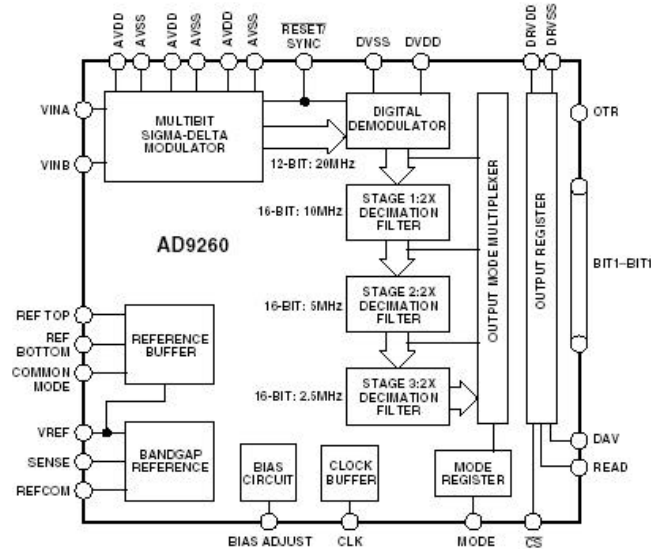
Heavy ion test

Part type:	<i>ADS8402</i>
Function:	<i>16-bit capacitor based SAR A/D Converter, 1.25 MHz, Unipolar Differential Input Range</i>
Manufacturer:	<i>Texas Instruments</i>
Package:	<i>48-pin TQFP</i>
Date Code:	-
Die Marking:	-
Die dimensions:	<i>3.82 mm x 3.82 mm</i>



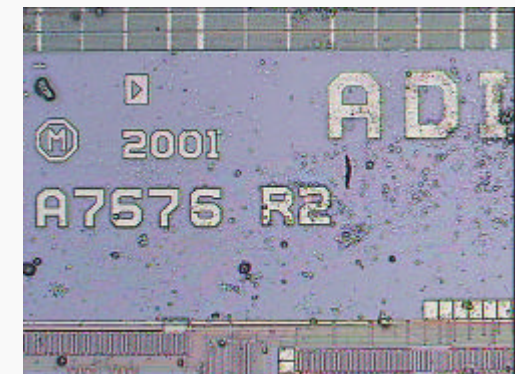
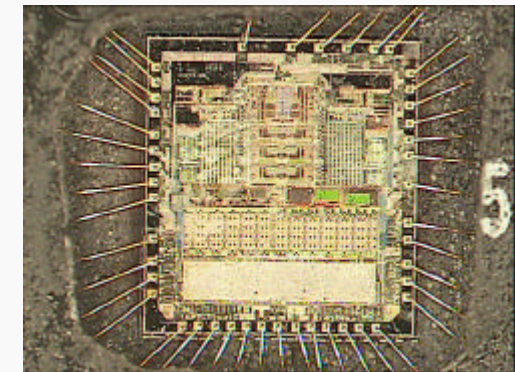
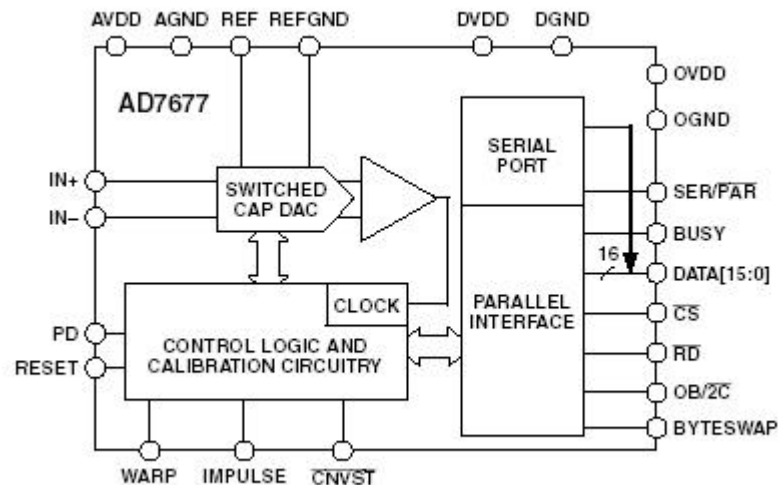
Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Part type: *AD9260AS*
 Function: *High Speed Oversampling CMOS ADC, 16-Bit resolution, 2.5MHz Output word rate*
 Manufacturer: *Analog Devices*
 Package: *44-Lead MQFP*
 Date Code: *0326*
 Die marking: *9260A HSC/WIL*
 Die dimensions: *5.70 mm x 6.20 mm*



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

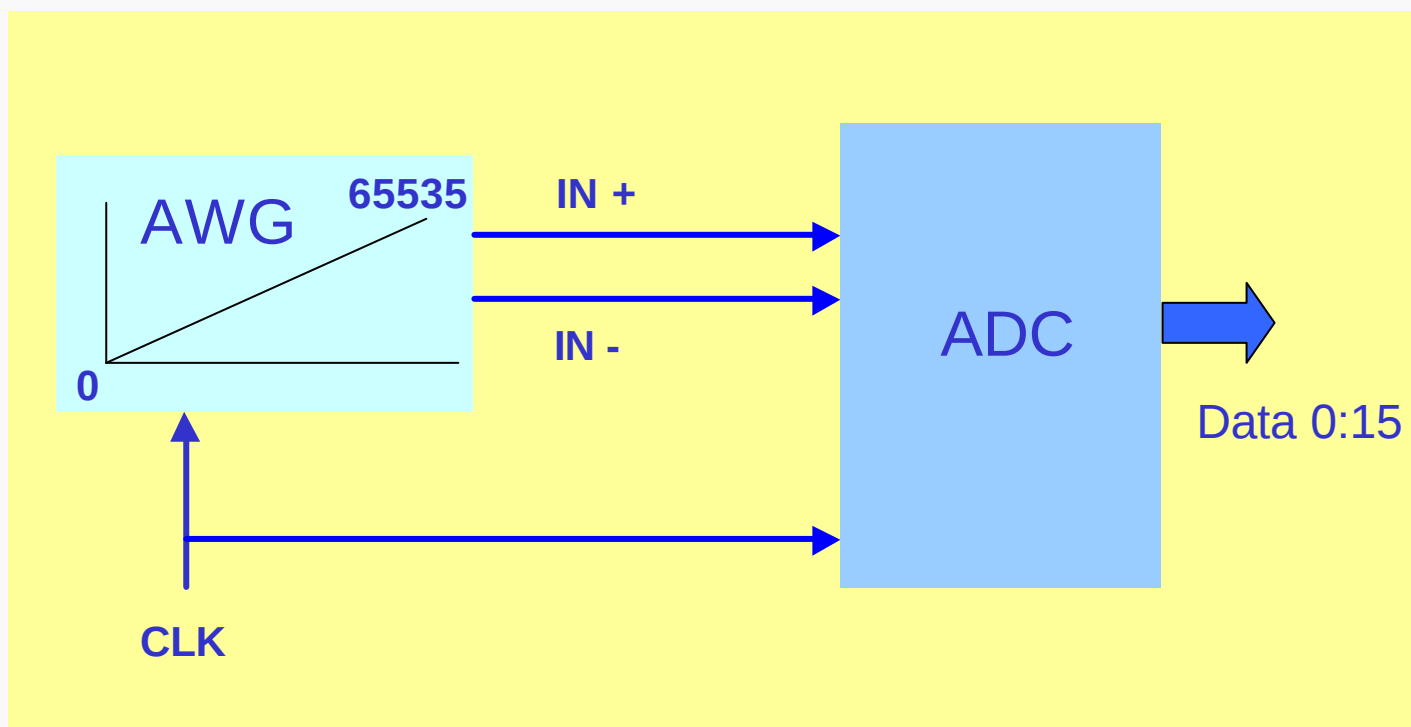
Part type: *AD7677A*
 Function: *16-bit, 1 MSPS, charge redistribution SAR, Fully differential, Single 5 V power supply.*
 Manufacturer: *Analog Devices*
 Package: *48-Lead Quad Flatpack (LQFP)*
 Quality Level: *-40°C to +85°C*
 Date Code: *0305*
 Die Marking: *2001 ADI A7676 R2*
 Die dimensions: *3.74 mm x 3.25 mm*



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

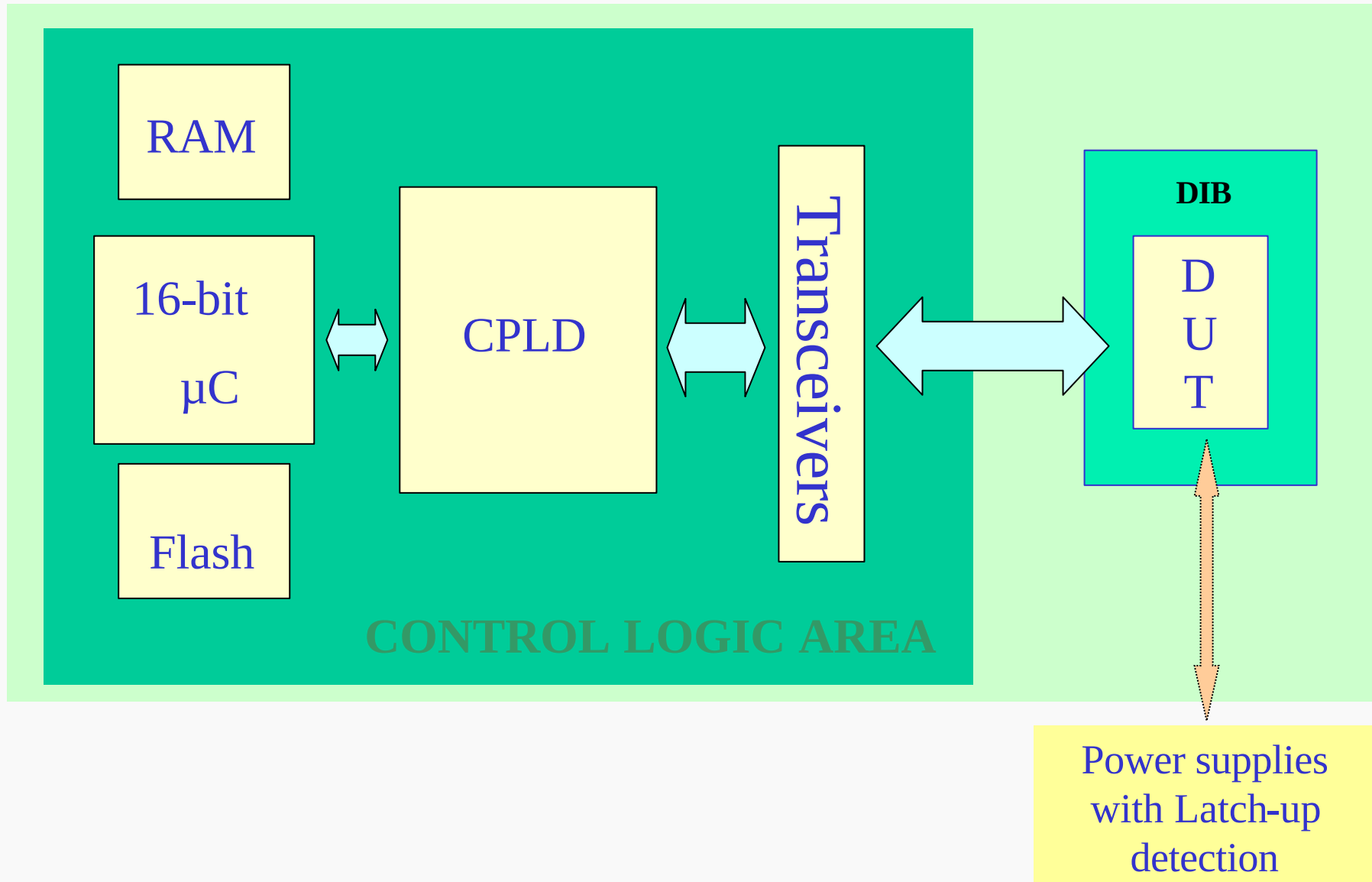
SEU Heavy ion test principle



Test performed at 0.45 MSPS

Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

UCL Cyclotron accelerator

Ion	Energy MeV	LET(Si) Mev/(mg/cm ²)	Range (Si) μm
N-15	62	2.97	64
Ne-20	78	5.85	45
Ar-40	150	14.1	42
ADS8402	N, Ne	2004 - 03 -11	
AD7677	Ne, Ar	2004 - 03 -12	
AD9260	Ne, Ar	2004 - 04 - 23	



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

RESULTS

AD7677

Tested with a ramp (2^{16} steps) at 0.45 MSPS.

Error if $|Read\ value - awaited\ value| > 40\ LSBs$

SEL detected with Ne at 0 deg. (LET 5.85 MeV/(mg/cm²))

Large errors (> threshold set to 200 or 500) could coincide with SEL occurrence or current peaks.

S/N 2 Fluence 5 E+05 #/cm² 7SEL on 0VDD

S/N 51 Fluence 5 E+05 #/cm² 7SEL on 0VDD, 1SEL on AVDD

Very few SEUs (single conversion errors) with N

N at 45 deg. (LET 4.20 MeV/(mg/cm²))

S/N 51 Fluence 1 E+06 #/cm² 3 SEUs



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

RESULTS

ADS8402

Tested with a fixed (programmable) input value at 0.45 MSPS.

Error if $|Read\ value - awaited\ value| > 10\ LSBs$

SEL threshold detected with Ne at 60 deg. (LET 11.70 MeV/(mg/cm²)
Large errors (> threshold set to 200 or 500) could coincide with SEL occurrence or current increases.

Ar at 0 deg. (LET 14.1 MeV/(mg/cm²)

S/N 1 Fluence 1.5 E+05 #/cm²

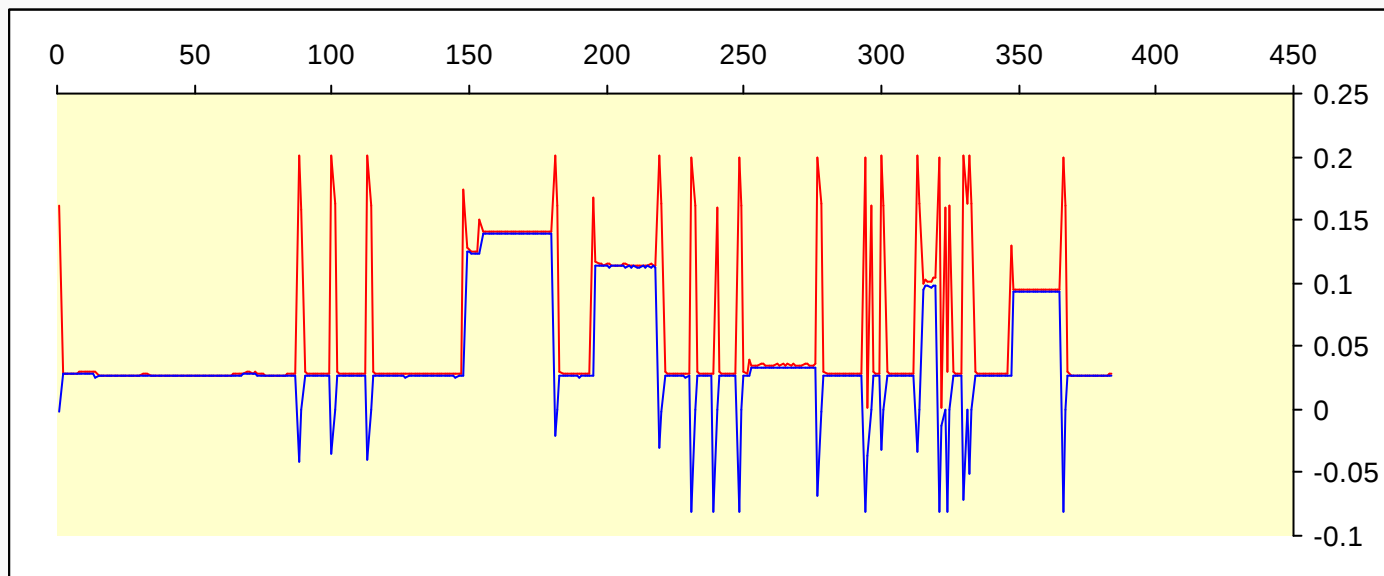
11SEL on AVDD, 1 SEL on 0VDD

Very few SEUs (single conversion errors)

Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

ADS8402, AVDD supply



SEL threshold set to 200mA

Ar at 60 deg. (LET 28.2 MeV/(mg/cm²), Fluence 5 E+04 #/cm²)



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

RESULTS

AD9260AS

SEL test (static)

Ne at 60 deg. LET 11.70 MeV/(mg/cm²)

Fluence 1 E+07 #/cm²

No SEL

Ar at 0 deg. LET 14.1 MeV/(mg/cm²)

Fluence 1.5 E+05 #/cm²

53 SELs (0VDD) & 10 SELs (AVDD)



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Heavy ion test

The 3 converters are sensitive to SELs.

This sensitivity could be related to the technology (no epitaxial layer to improve noise immunity)

AD7677 presents the lower SEL threshold (LET of 5.85 MeV/(mg/cm²).

*Limitation on ion penetration range could affect the SEL results:
see AD9260 results with Ne at 60 deg. (LET 11.7) and Ar at 0 deg. (LET 14.1)*



Radiation Evaluation of 16-Bit Analog-to-Digital Converters

Electrical characterization and Total Dose test

1 Test board Ready

At Present, working on the improvement of the quality of the input signal (from the 16-bit AWG) to get adequate measurement accuracy.