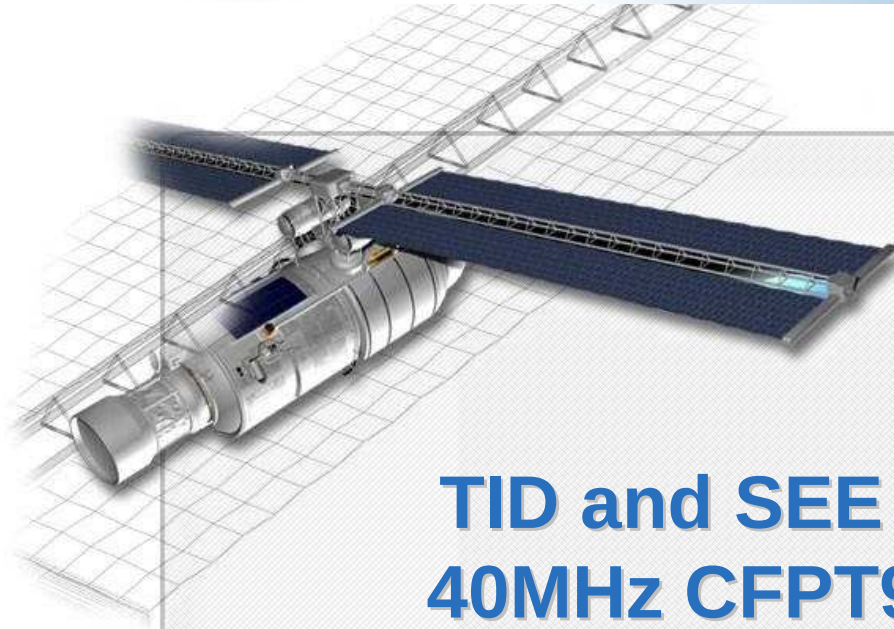




TID and SEE characterisation of 40MHz CFPT9006 oscillator from Rakon

Presented by Athina VAROTSOU

**Work performed by Pierre GARCIA, Yannick PADIE, Benjamin
RENAUD, and Benjamin VANDEVELDE**

- **The project**
- **TID tests**
 - Parts, bias conditions, irradiation time log, measured parameters
 - Results
- **SEE tests**
 - Parts, beam description, test system
 - Results
- **Conclusions**

The project

- The CFPT9006 from Rakon: a single chip oscillator and analogue circuit, able to function down to a supply voltage of 2.4V, with low power consumption.
- Goal: radiation pre-screening to assess the radiation tolerance of the XO oscillator internal ASIC.
- COO1 of the frame contract *ECI Phase 3, radiation characterisation of commercial EEE Components for Space Applications*.

TID tests: Parts

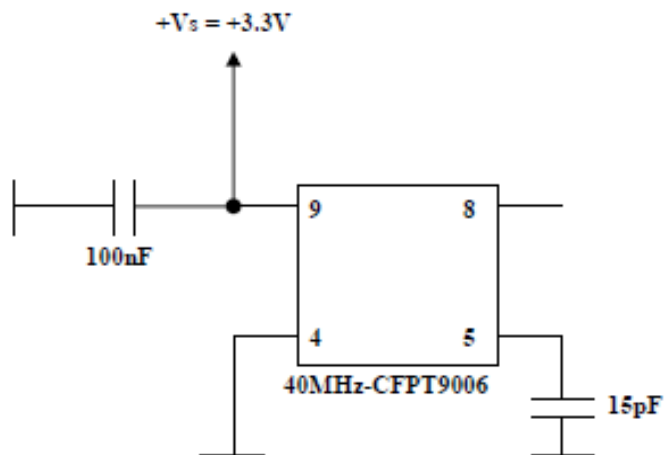
PART IDENTIFICATION	
Type :	40MHz-CFPT9006
Manufacturer :	RAKON
Function :	SMD Temperature Compensated Crystal Oscillator (PLUTO)

PARTS PROCUREMENT INFORMATION	
Packaging :	SMD
Sample size :	15 irradiated samples + 1 reference sample

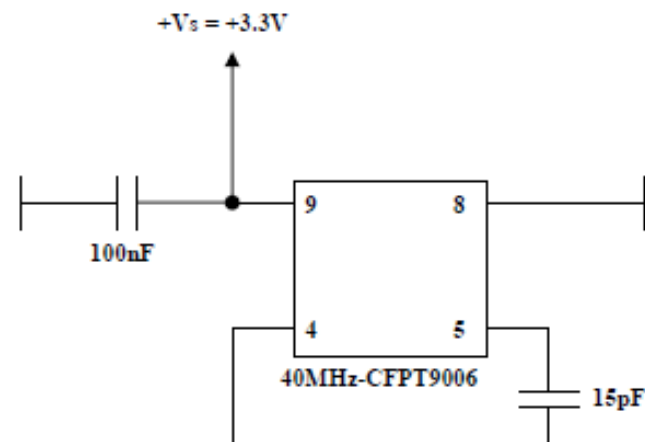
TID tests: Bias conditions

- 5 parts biased in static ON Mode 1 and 5 parts biased in static ON Mode 2:

Mode 1



Mode 2



- 5 parts biased in OFF mode.

TID tests: Irradiation time log

Irradiation facility: ^{60}Co at U.C.L.

IRRADIATION TIME LOG								
Total dose limit (krad(Si))	100							
Level for measurement (krad(Si))	0	9	21	30	50	58	80	100
Dose rate (krad(Si)/h)	0.31							

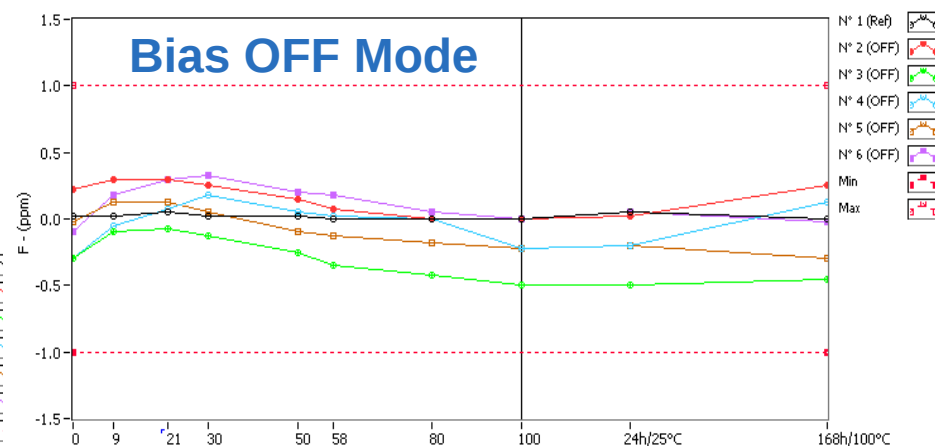
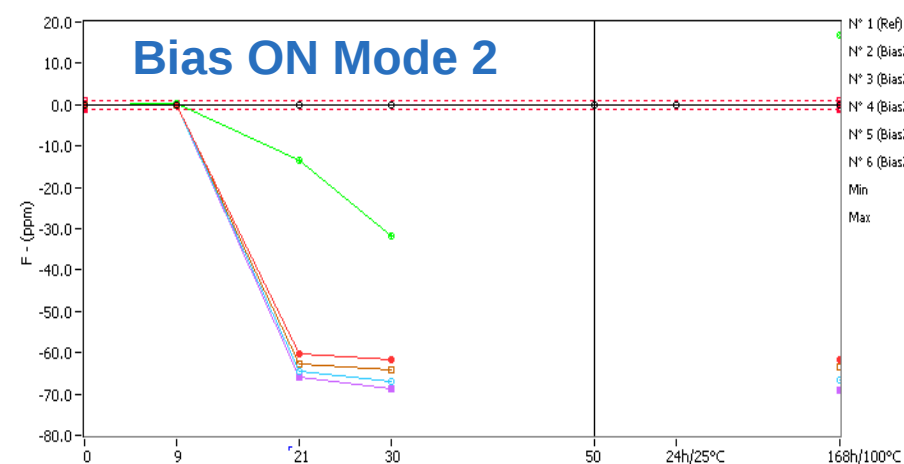
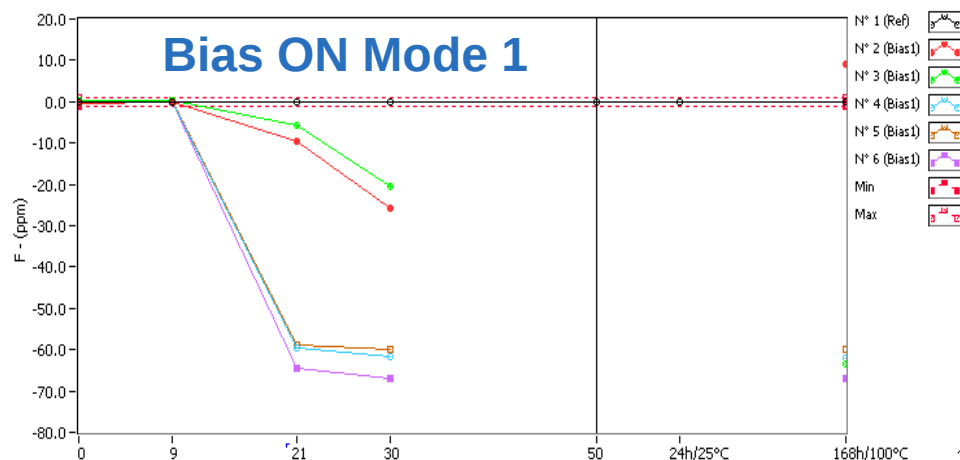
TID tests: Measured parameters

PARAMETERS	SYMBOLS	TEST CONDITIONS
Ta = 25°C , +Vs = 3.3V , unless otherwise specified		
Frequency calibration	F	
Supply voltage stability	Fstab	+2.97V < +Vs < +3.63V
Supply current	Is	
Output voltage level low	VOL	
Output voltage level high	VOH	
Rise time	Tr	10% to 90% level
Fall time	Tf	90% to 10% level
Duty cycle	Dc	at 50% level
Tristate input high voltage	VIH	
Tristate input low voltage	VIL	

TID tests: Results

Param.	ON-Mode 1	ON-Mode 2	OFF-Mode
F	out of spec. @ 9.2 krad (Si)	out of spec. @ 9.2 krad (Si)	within spec.
Fstab	out of spec. @ 10.4 krad (Si)	out of spec. @ 11.1 krad (Si)	within spec.
Is	out of spec. @ 12.8 krad (Si)	out of spec. @ 12.9 krad (Si)	within spec.
Dc	out of spec. @ 20.5 krad (Si)	out of spec. @ 21.1 krad (Si)	within spec.
VOL	not measurable @ 50 krad (Si)	not measurable @ 50 krad (Si)	within spec.
VOH	- // -	- // -	within spec.
Tr	- // -	- // -	within spec.
Tf	- // -	- // -	within spec.
VIH	- // -	- // -	within spec.
VIL	- // -	- // -	within spec.

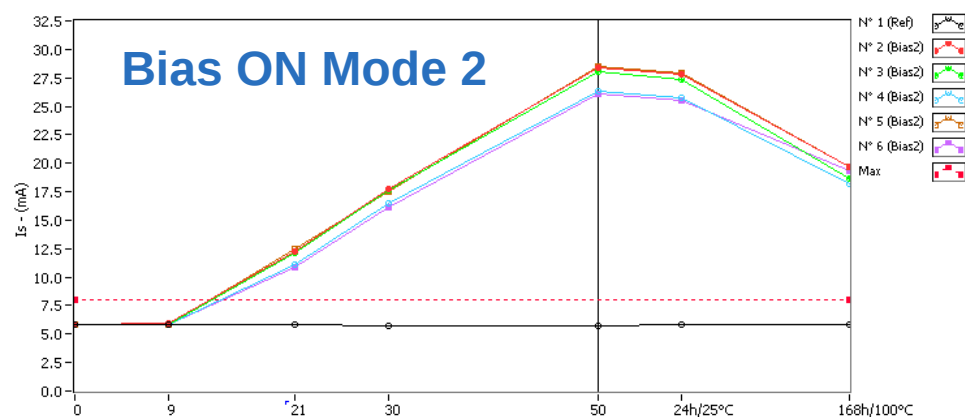
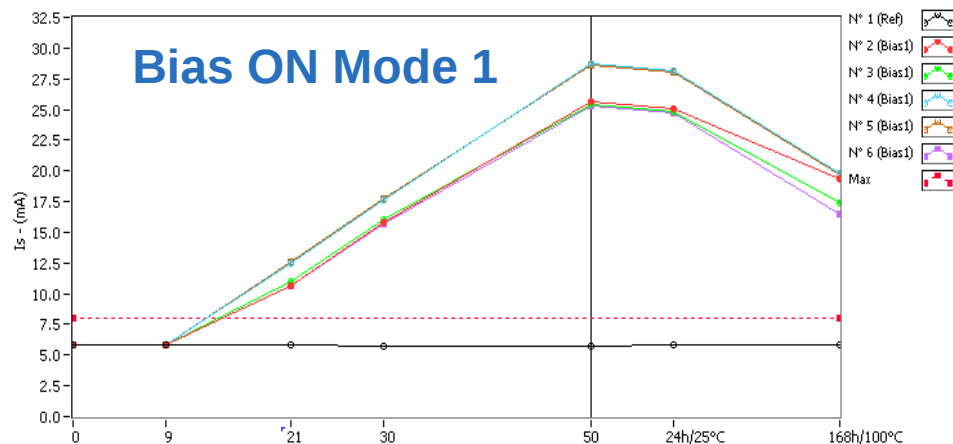
TID tests: Results for F parameter



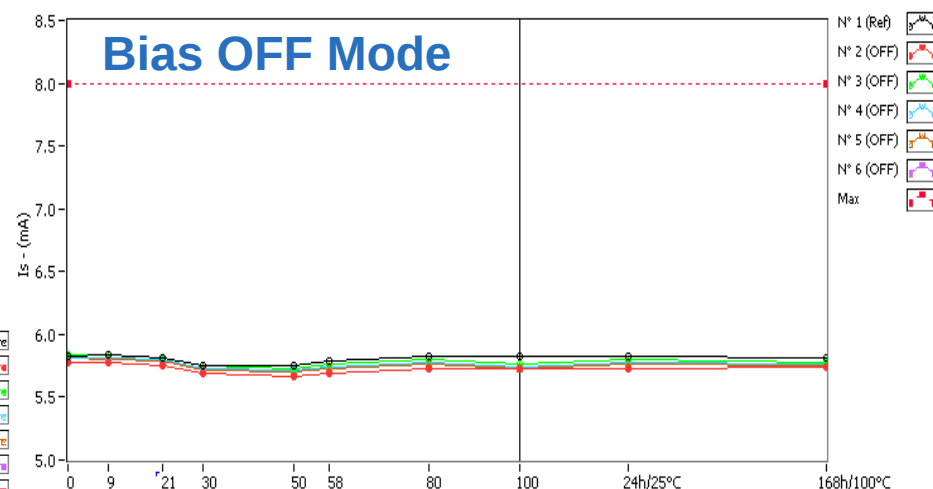
Within specification @ 100 krad(Si)

Out of specification @ 9.2 krad (Si)

TID tests: Results for Is parameter



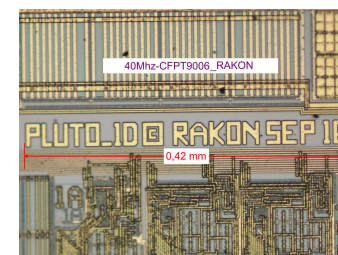
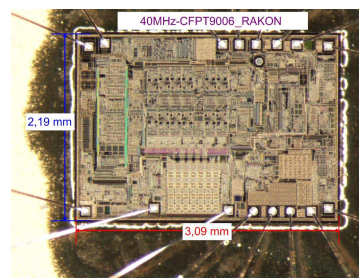
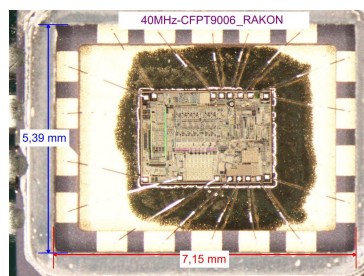
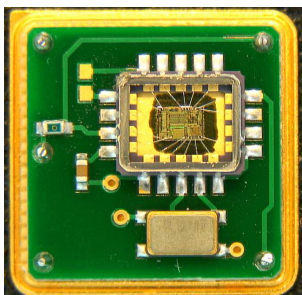
Out of specification @ 12.8 krad (Si)



Within specification @ 100 krad(Si)

SEE tests: Parts

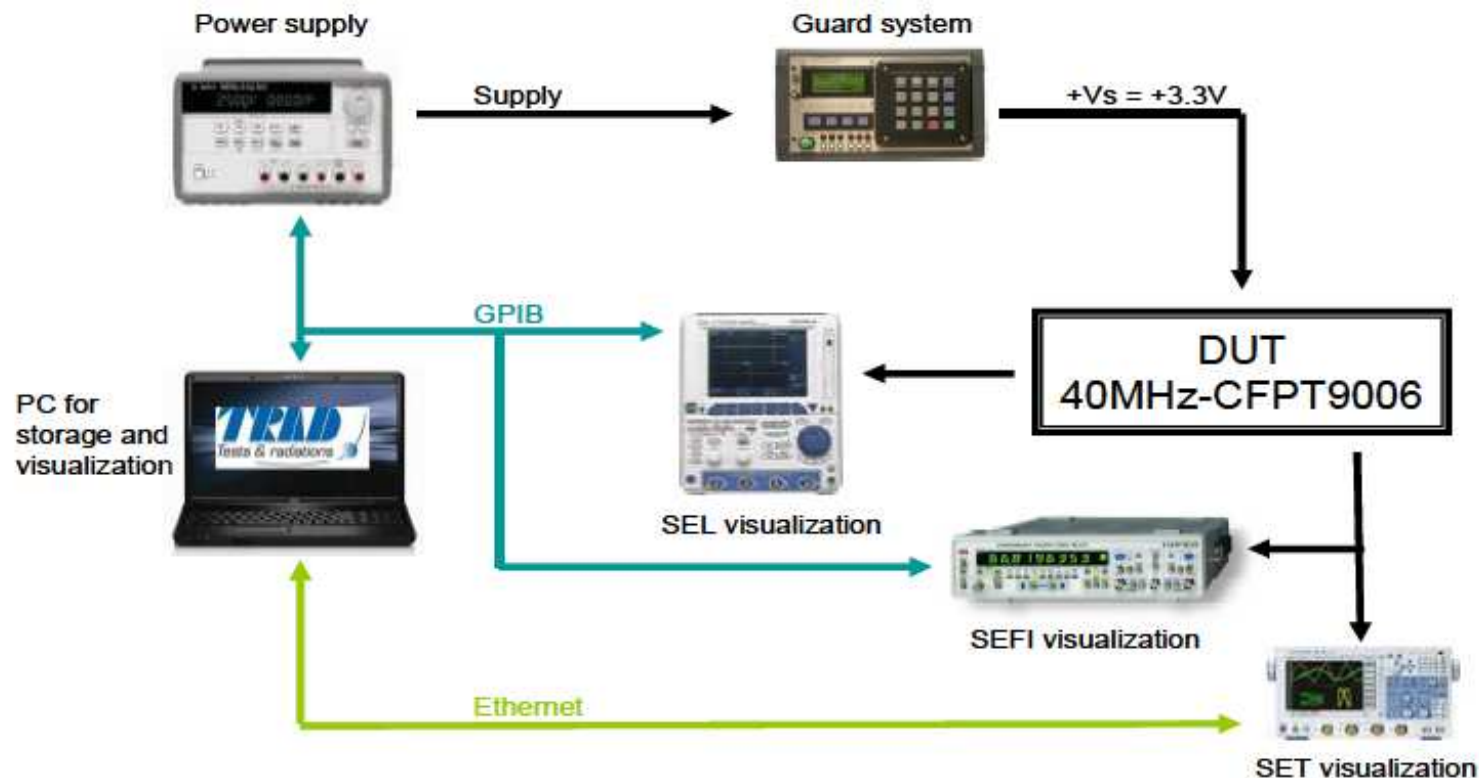
PART IDENTIFICATION	
Type :	40MHz – CFPT9006
Manufacturer :	Rakon
Function :	SMD Temperature Compensated Crystal Oscillator (PLUTO)
PARTS PROCUREMENT INFORMATIONS	
Packaging :	Specific with 5 pins
Sample size:	4 irradiated samples during the first campaign and 3 irradiated samples during the second campaign (one part was reused from the first campaign).



Irradiation facility: U.C.L.

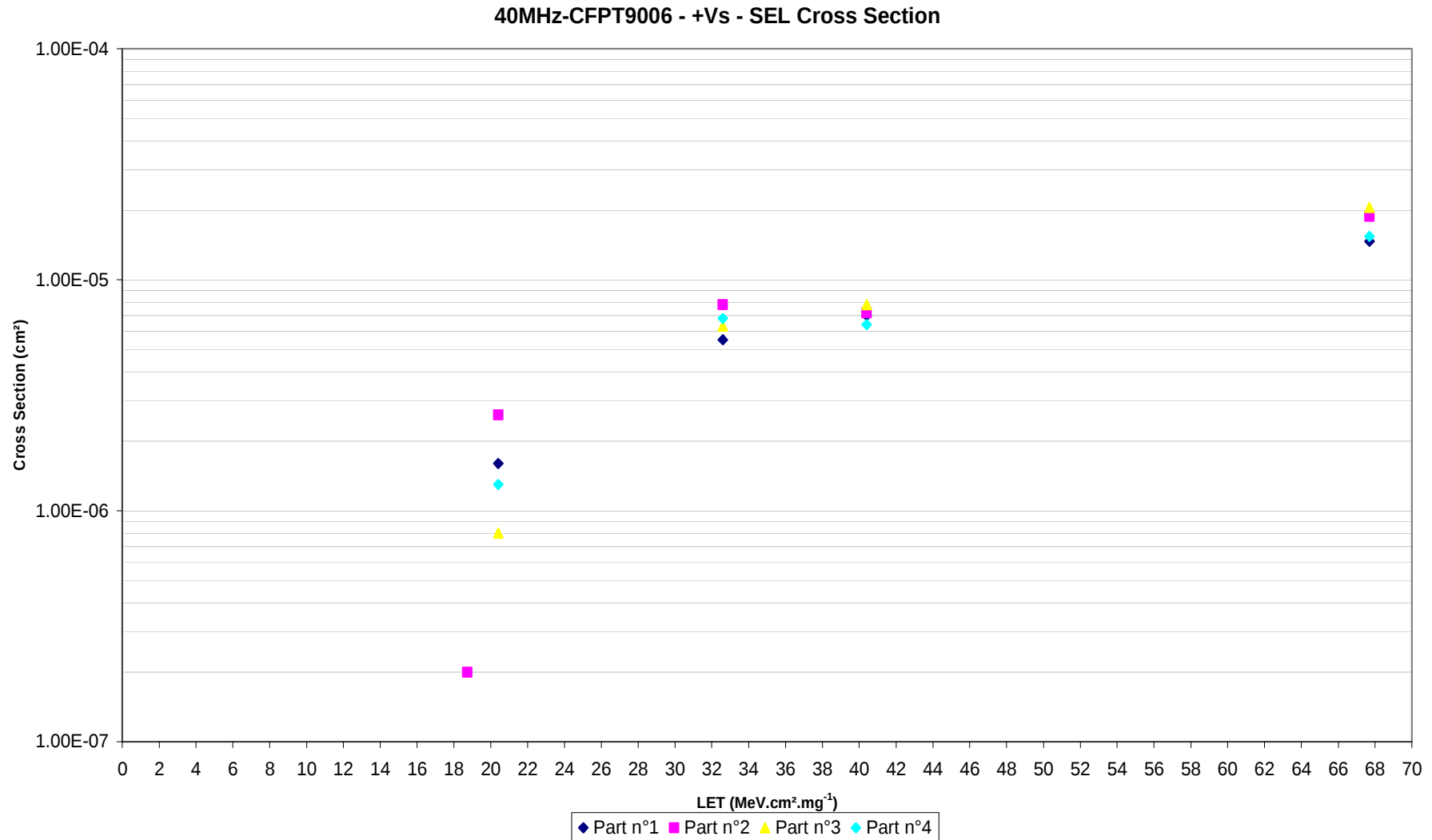
IRRADIATION BEAM CHARACTERISTICS	
Heavy Ions used :	Cocktail n°1 : $^{124}\text{Xe}^{26+}$, $^{84}\text{Kr}^{17+}$ Cocktail n°2 : $^{83}\text{Kr}^{25+}$, $^{58}\text{Ni}^{18+}$, $^{40}\text{Ar}^{12+}$, $^{22}\text{Ne}^{7+}$ $^{13}\text{C}^{4+}$ Cocktail n°2 (2 nd campaign) : $^{58}\text{Ni}^{18+}$, $^{40}\text{Ar}^{12+}$,
Vacuum:	1.3 E-4 mbar
Flux range :	Cocktail n°1 : $1,12 \cdot 10^2$ to $1,56 \cdot 10^4$ ions/cm ² .s Cocktail n°2 : $1,90 \cdot 10^2$ to $1,59 \cdot 10^4$ ions/cm ² .s Cocktail n°2 (2 nd campaign) : $4,88 \cdot 10^3$ to $1,78 \cdot 10^4$ ions/cm ² .s
Fluence range :	Cocktail n°1 : $1,19 \cdot 10^4$ to $1,10^7$ ions/cm ² Cocktail n°2 : $2,64 \cdot 10^3$ to $1,10^7$ ions/cm ² Cocktail n°2 (2 nd campaign) : $1 \cdot 10^6$ to $1 \cdot 10^7$ ions/cm ²
Particle angle :	Cocktail n°1 : 0° Cocktail n°2 : 0°, 50° and 57° Cocktail n°2 (2 nd campaign) : 0°

SEE tests: Test system



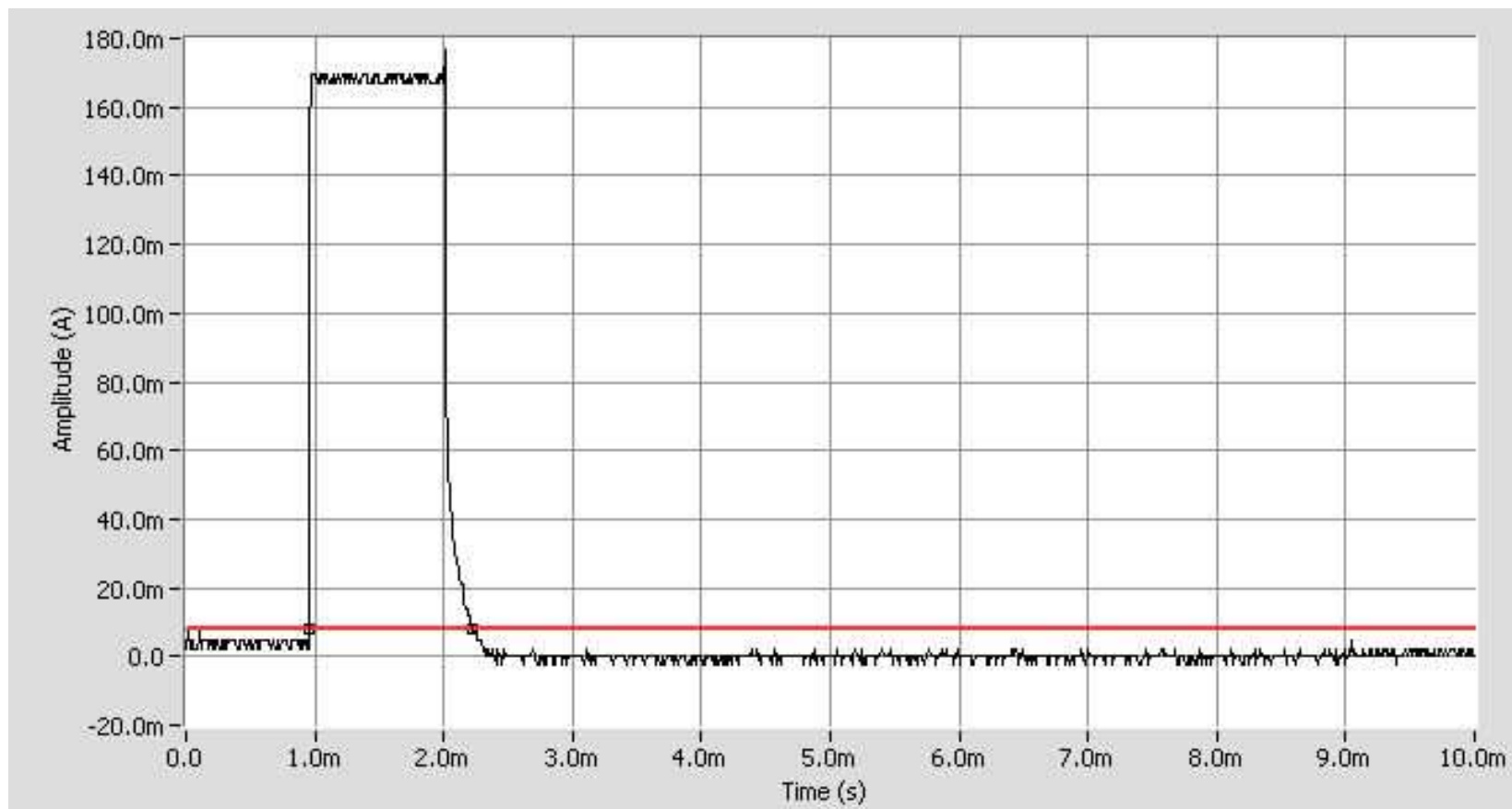
* A test is terminated when the maximum fluence is reached or 100 events are observed.

SEE tests: SEL test results



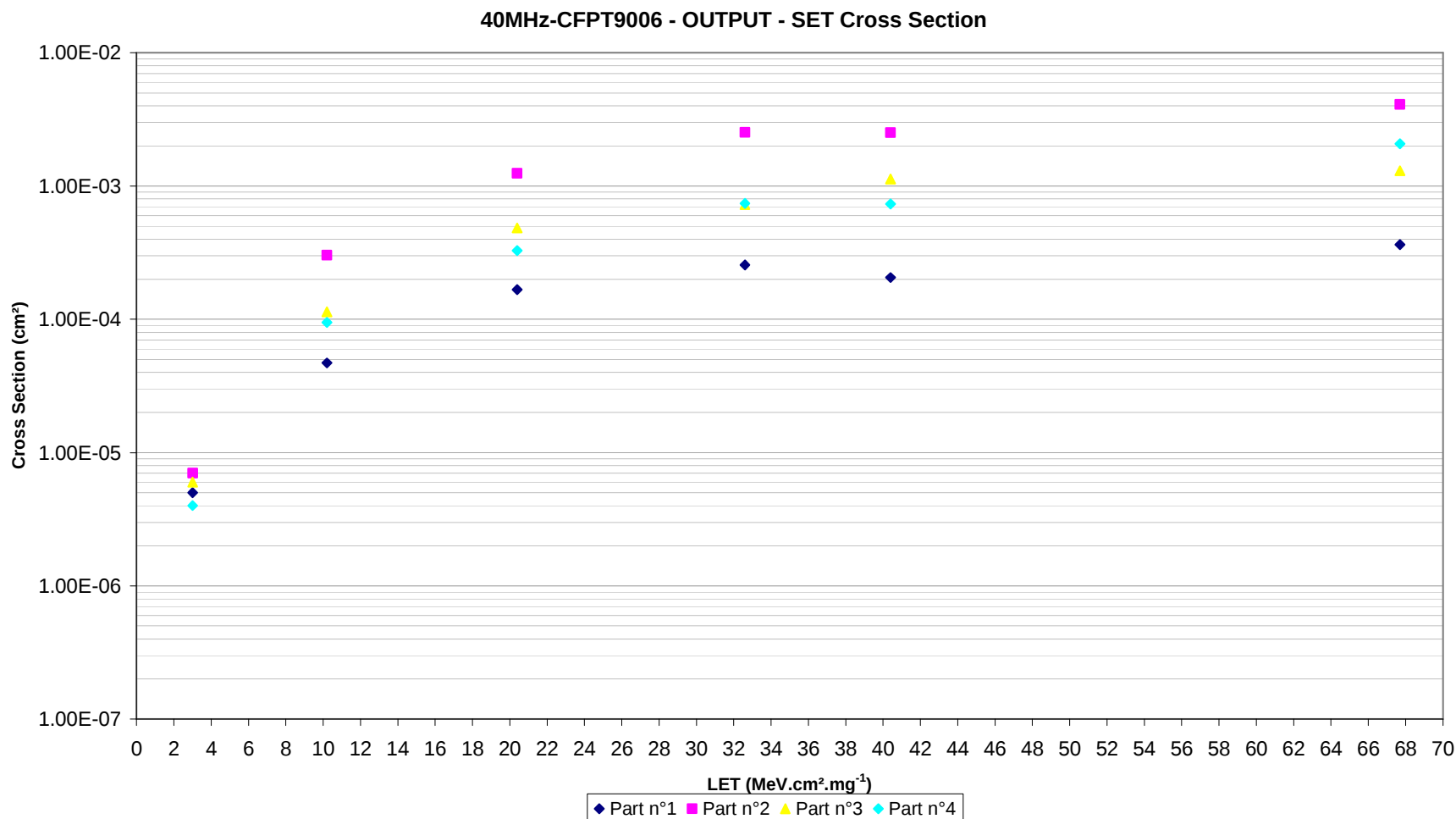
* SEL tests were performed at 85°C

SEE tests: Worst case SEL



Heavy Ion $^{124}\text{Xe}^{26+}$, Part 4, run n°6 event n°62

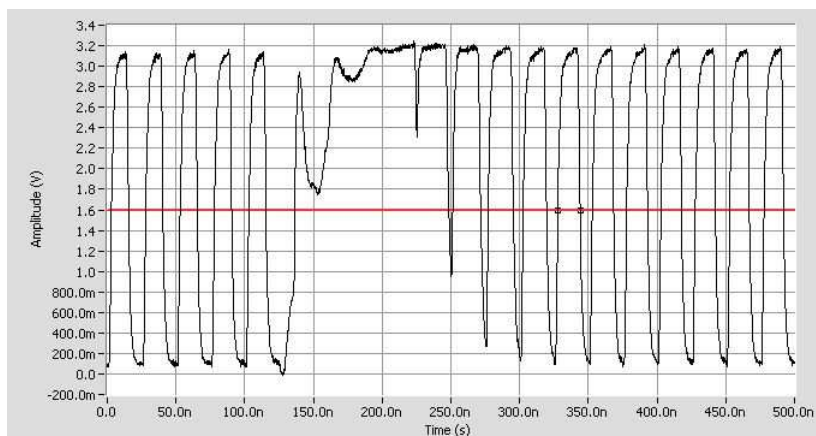
SEE tests: SET test results



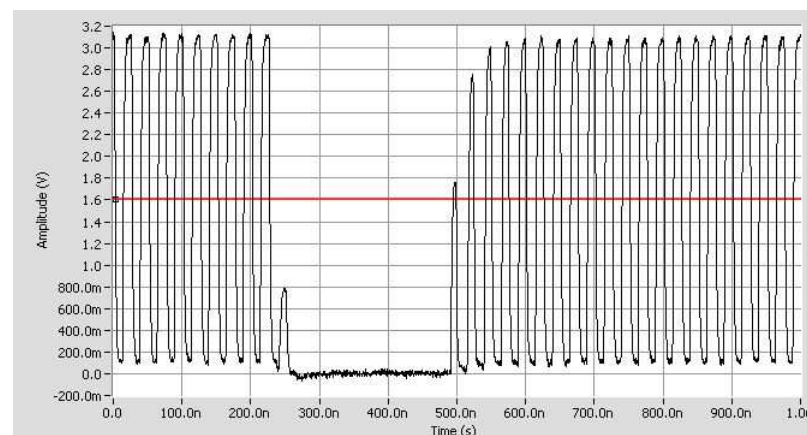
* The GUARD SYSTEM is always used on the component's power supply to detect SEL + prevent the destruction of the device under test.

* SET test were performed at 25°C.

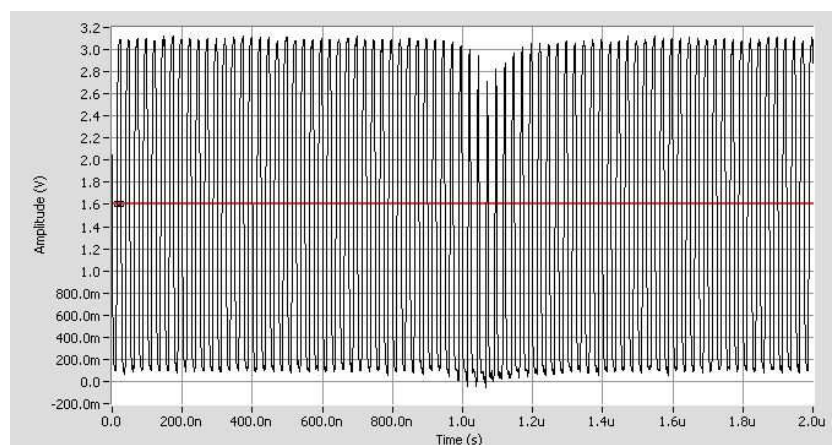
SEE tests: SET events



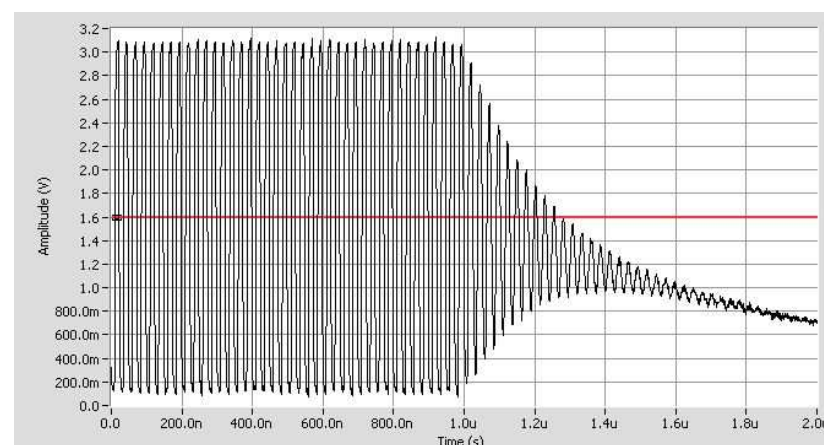
$^{124}\text{Xe}^{26+}$, Part 4, Run n°10, Event n°104



$^{84}\text{Kr}^{17+}$, Part 4, Run n°17, Event n°59



$^{84}\text{Kr}^{17+}$, Part 1, Run n°23, Event n°67

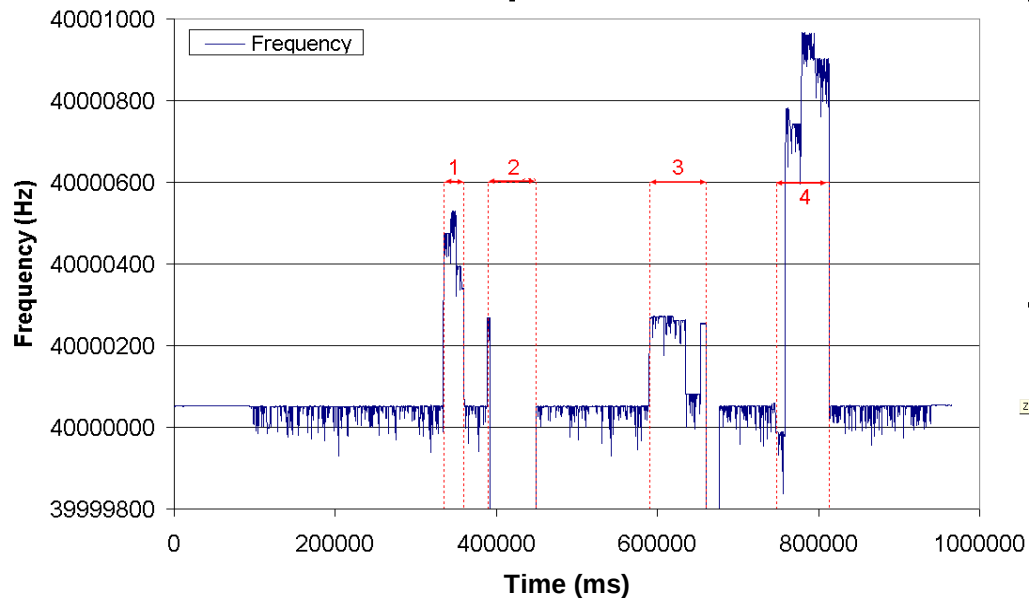


$^{83}\text{Kr}^{25+}$, Part 1, Run n°38, Event n°60

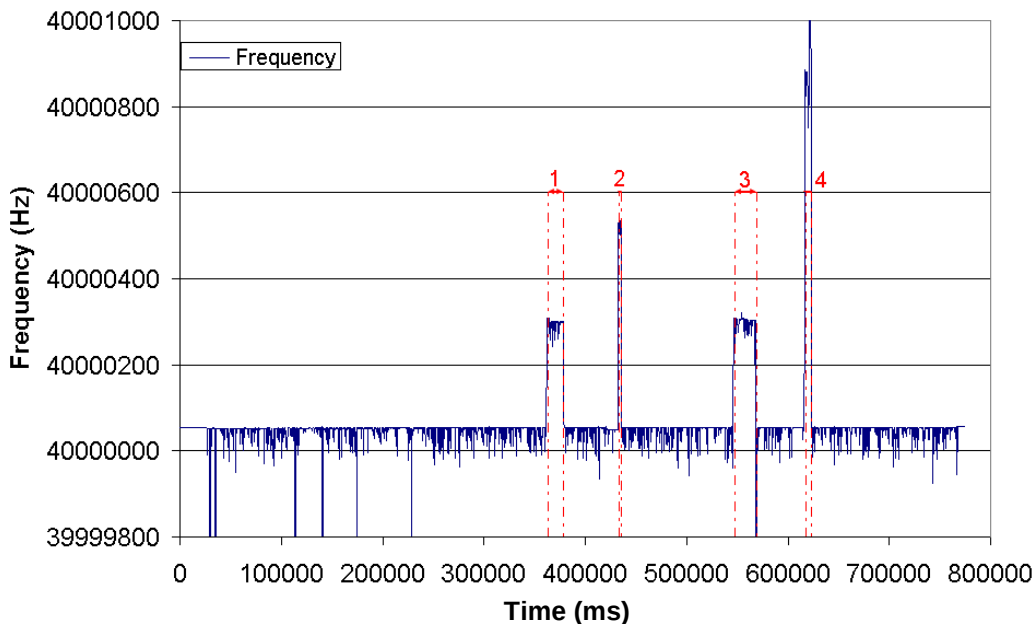
SEE tests: SEFI test principle

- A frequency meter was used.
- The output frequency was checked every 100ms: a SEFI was registered when a frequency shift of 1ppm was observed or a loss of frequency occurred.
- Automatic restart (Power Supply) was disabled.

SEE tests: SEFI test results



Nickel ions up to the fluence of $1E7 \text{ cm}^{-2}$



■ TID characterisation

- Parameters for ON biased parts (Mode 1 & 2) are measurable up to 30 krad(Si).
- Several parameters were measured out of specification (F, Fstab, Is, Dc) in the ON modes for TID < 30krad(Si).
- No drift of parameters for parts on OFF mode.

■ SEE characterisation

- Parts sensitive to SEL, SET and SEFI.