SET Characterization of Parts for the ATV Project:

IRFY140 Power MOSFET, LM185 Voltage Reference Diode and SMFL2805S DC-DC Converter

ESTEC Contract No. 13528/99/NL/MV, COO-16

Hirex Engineering SAS

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Estec Technical Officer

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SET Characterization of Parts for the ATV Project:

Work performed under this contract:

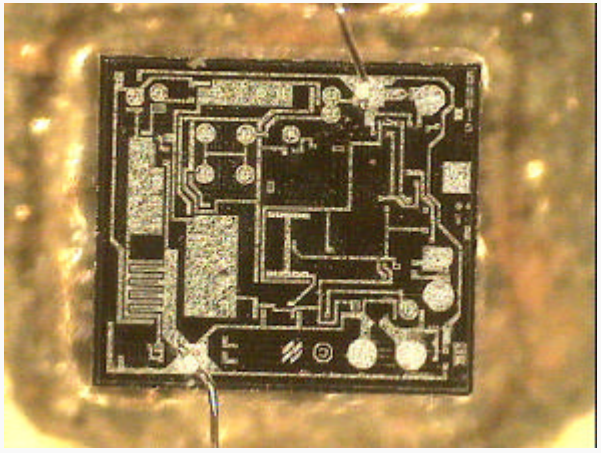
Heavy ions testing using ATV actual application conditions

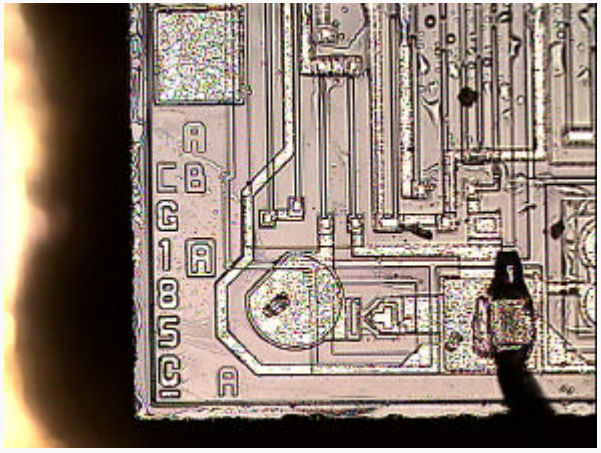
LM185	*Voltage Regulator Diode*
IRFY140	*100V N-Channel MOSFET Transistor*
SMFL2805S	*28V Input DC/DC Converter*

SET Characterization of Parts for the ATV Project:

LM185 (1/9)

Part type:	*LM185*
Function:	*2-Terminal Bandgap Voltage Regulator Diode*
Manufacturer:	*National Semiconductor*
Package:	*TO-46*
Quality Level:	*Hi-Rel*
Date Code:	*0134*
Detail specification:	*SMD 5962-8759402XA (WE5000017484)*
Die Marking:	*G185C*
Die dimensions:	*1.47 mm x 1.29 mm*

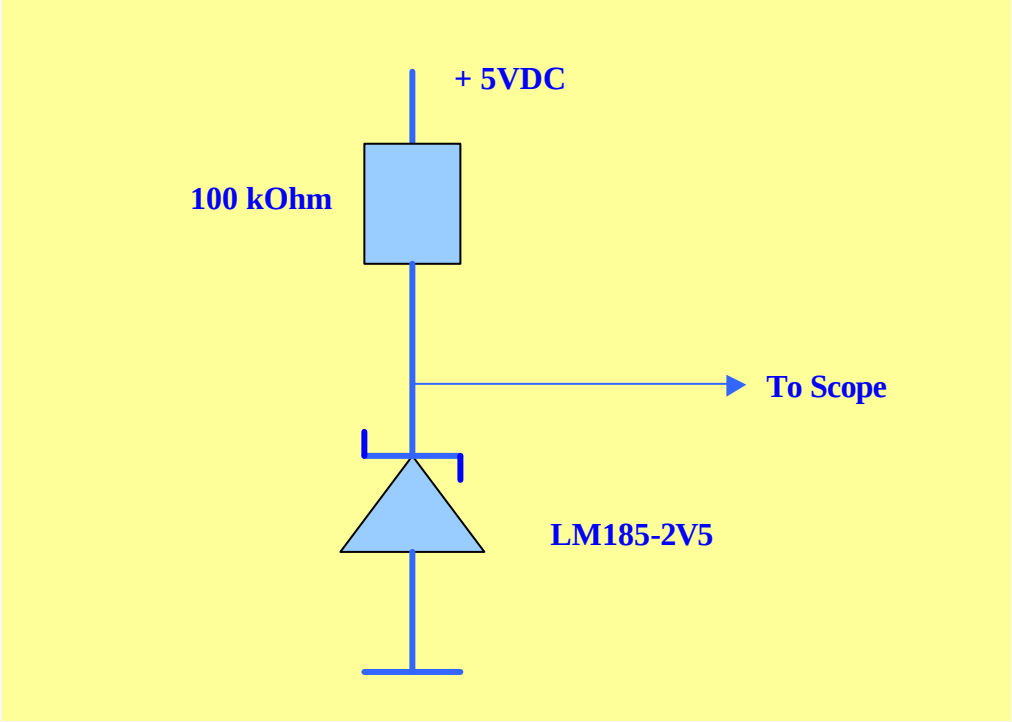




SET Characterization of Parts for the ATV Project:

LM185 (2/9)

Bias Conditions
As per ATV-RIBRE-DFX-0281-03, EADS fax dated 22/08/03, page 2



Oscilloscope:1MOhm Input, trigger level: Vdut +/- 50mV

SET Characterization of Parts for the ATV Project:

LM185 (3/9)

BNL Tandem Van de Graaff accelerator 2004-01-17

Ion	**Energy** MeV	**LET(Si)** Mev/(mg/cm²)	**Range (Si)** µm
F-19	140	3.38	120.4
Cl-35	199	11.73	59.41
Ni-58	265	26.58	42.23
Au-197	333	81.44	27.53

RESULTS

Preliminary runs show that only negative events occurred but with a possible positive overshoot:

➔ trigger level was fixed to -50mV for all runs.

DUT output voltage slightly out of specification: further verification showed that die was light sensitive

SET waveforms

•Negative Pulse:

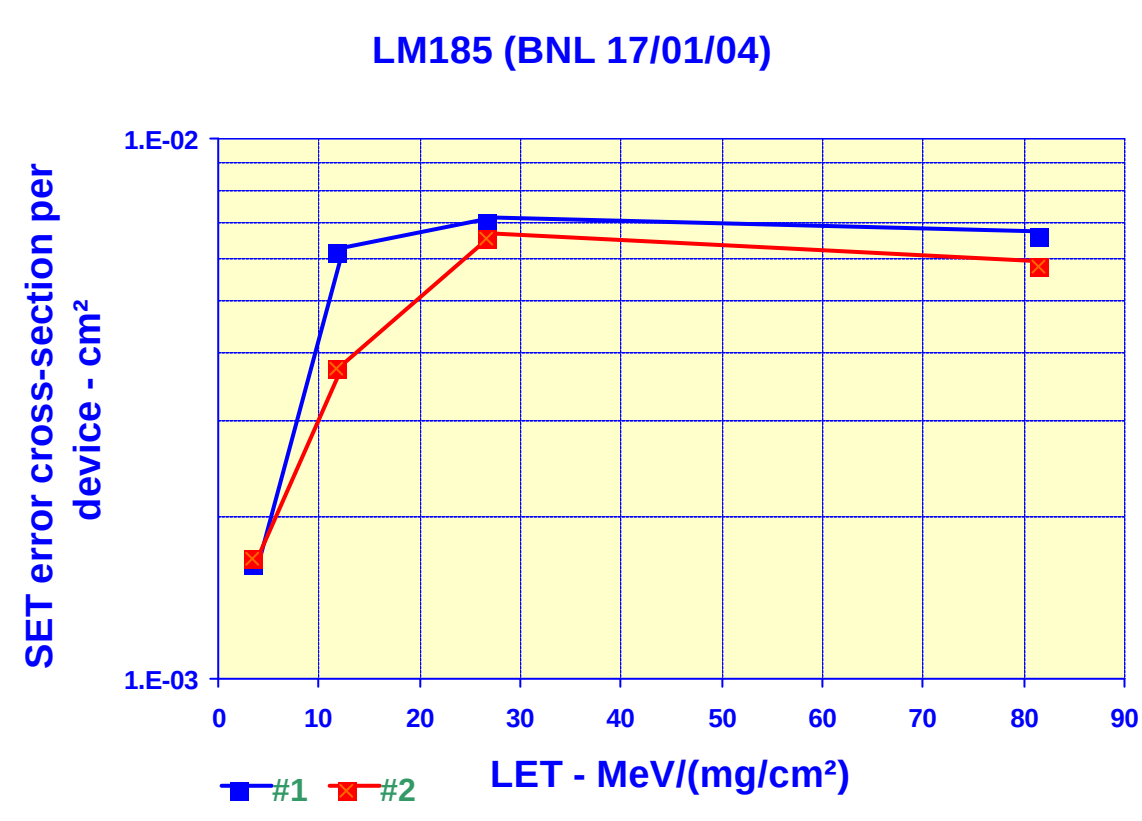
Worst case: amplitude 400mV, FWHM 20µs

•Overshoot Pulse:

Worst case: amplitude 200mV, FWHM 40µs

SET Characterization of Parts for the ATV Project:

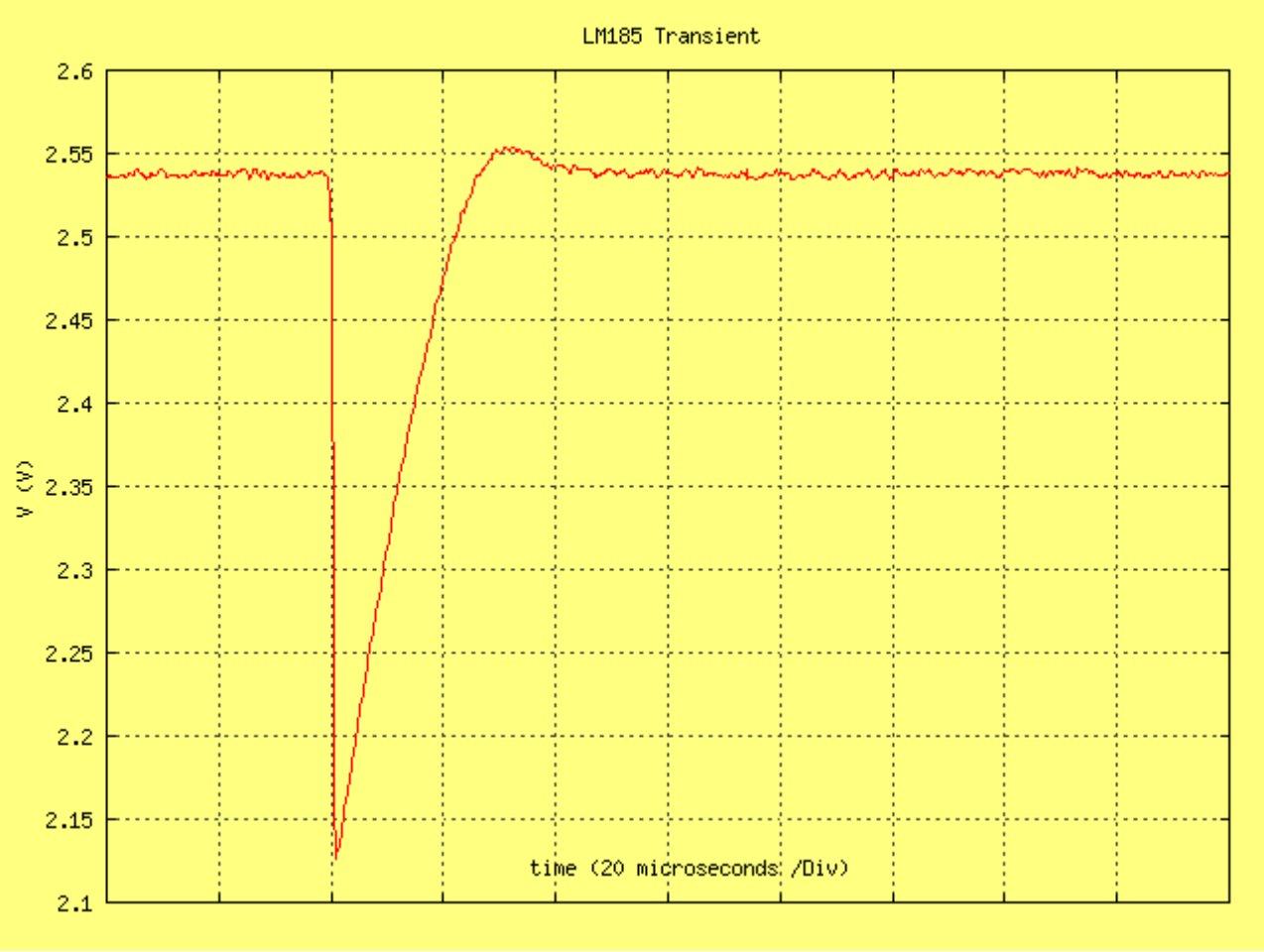
LM185 (5/9)



Trigger level -50mV

SET Characterization of Parts for the ATV Project:

LM185 (6/9)

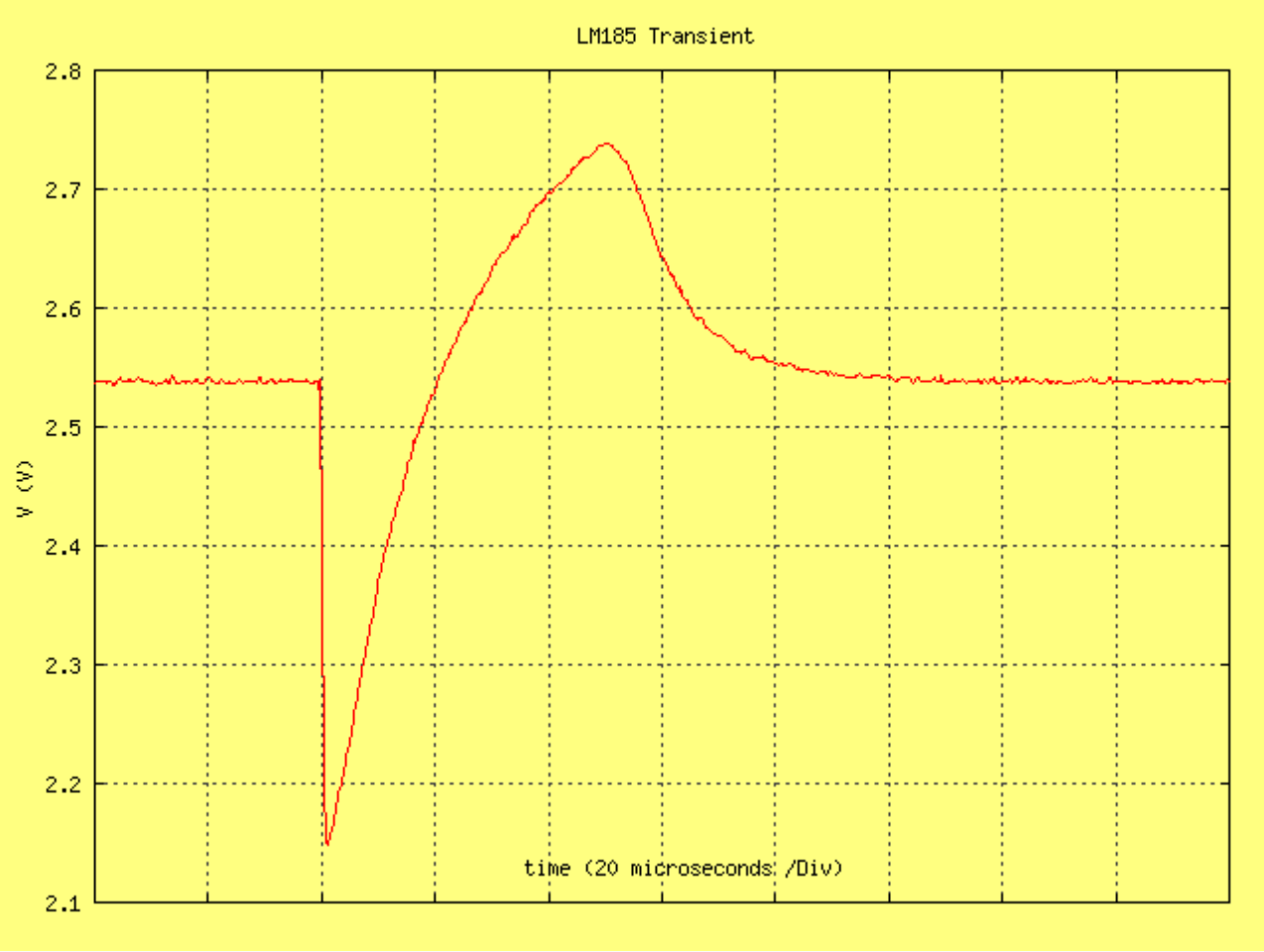


Run 5

- NI-58 ion
- LET of 26.58
- Worst case negative SET

SET Characterization of Parts for the ATV Project:

LM185 (7/9)

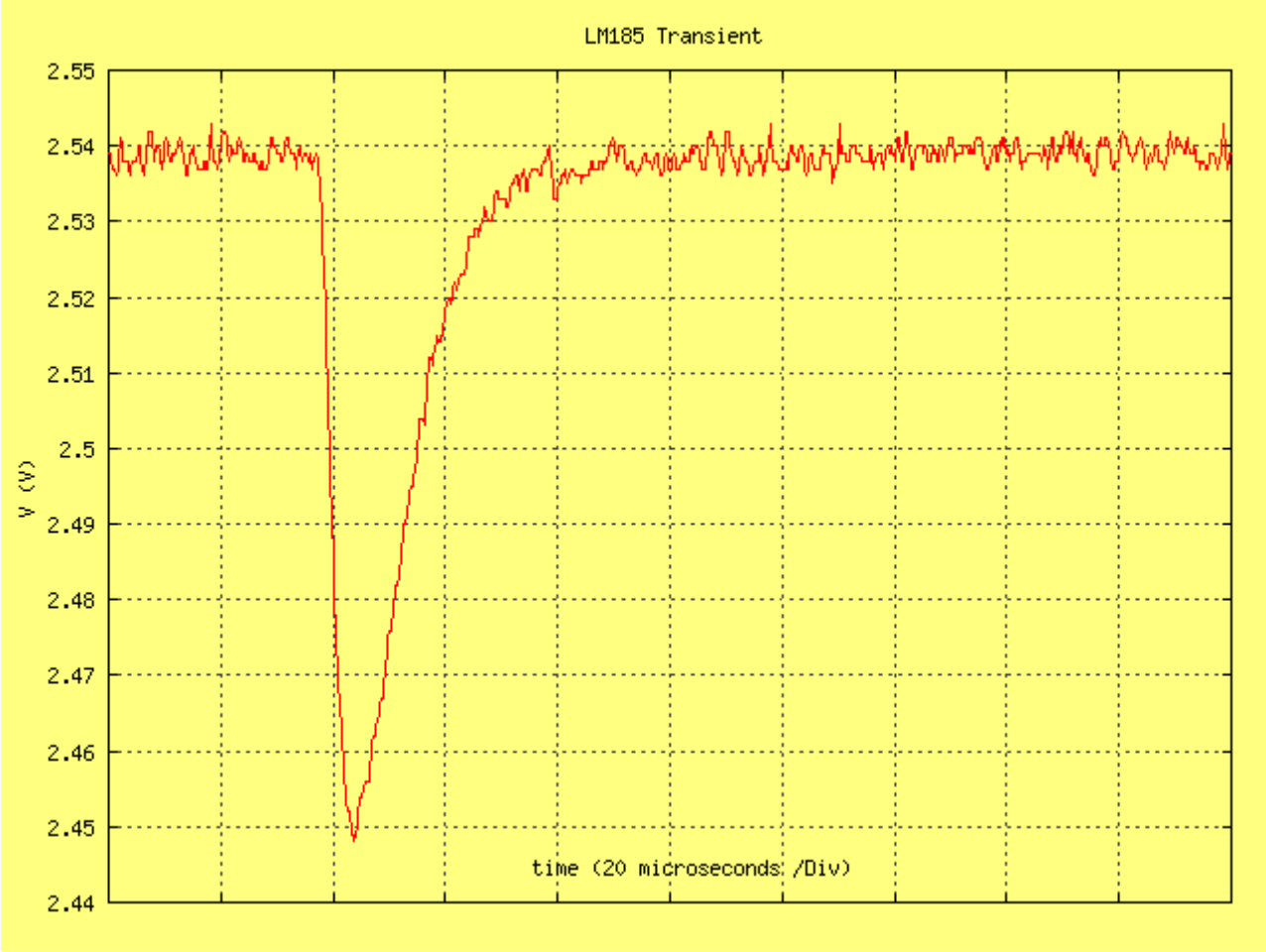


Run 5

- NI-58 ion
- LET of 26.58
- SET with positive overshoot

SET Characterization of Parts for the ATV Project:

LM185 (8/9)

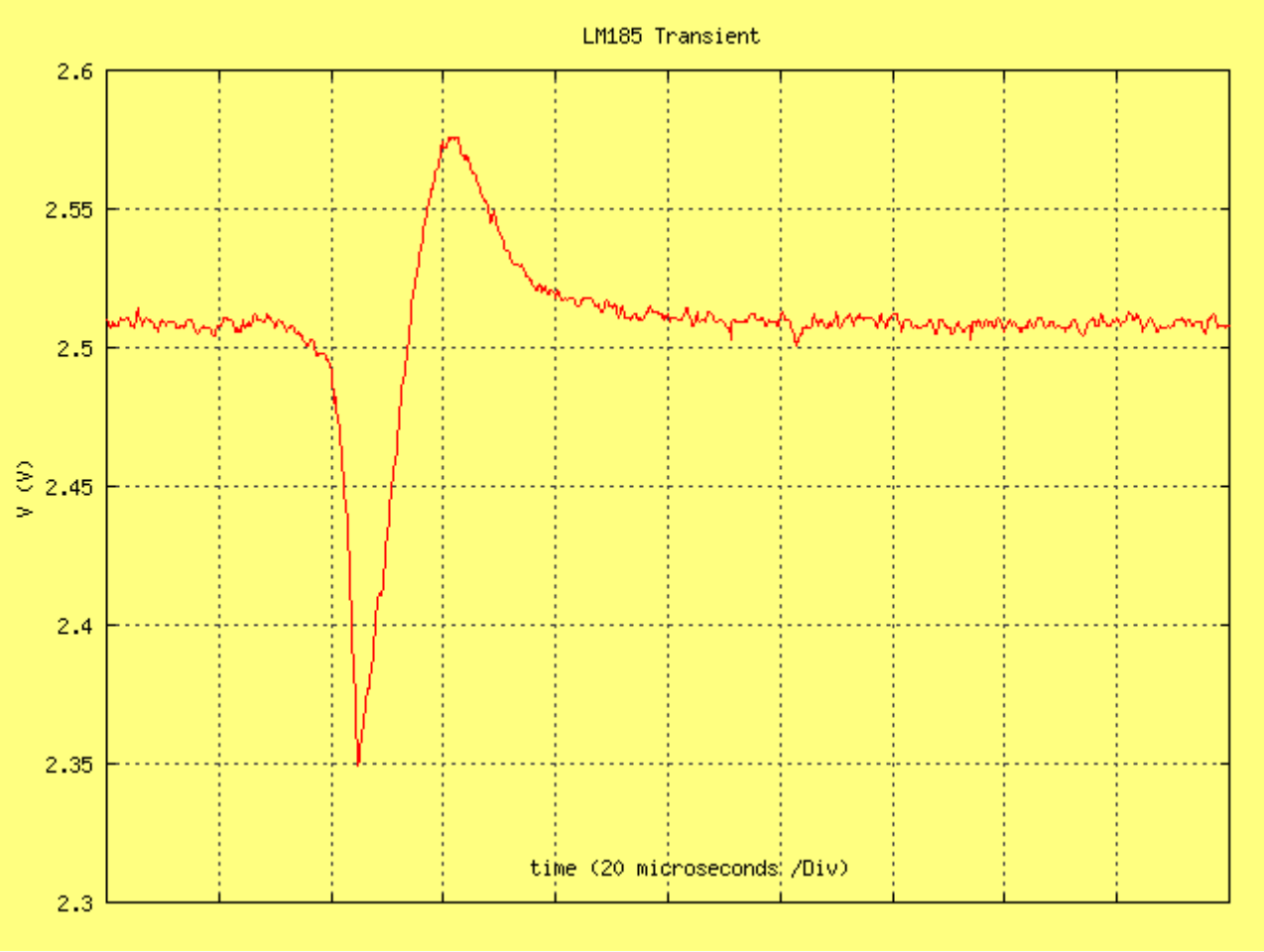


Run 9

- F-19 ion
- LET of 3.38
- Typical SET

SET Characterization of Parts for the ATV Project:

LM185 (9/9)



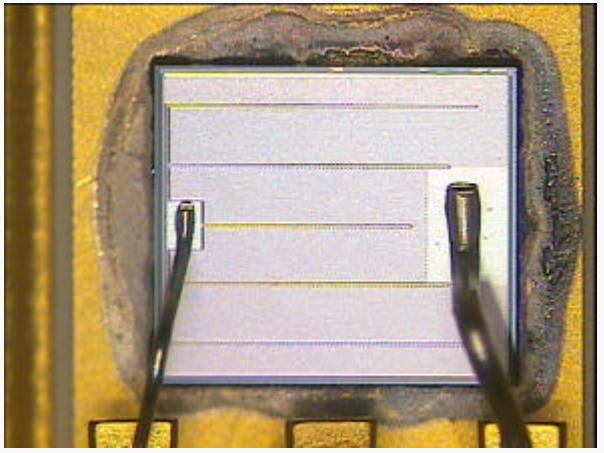
Run 9

- F-19 ion
- LET of 3.38
- Worst case SET recorded

SET Characterization of Parts for the ATV Project:

IRFY140 (1/5)

Part type:	*IRFY140*
Function:	*100V N-Channel MOSFET Transistor*
Manufacturer:	*International Rectifier*
Package:	*TO-257A*
Quality Level:	*Hi-Rel*
Date Code:	*9730*
Detail specification:	*MA5000AKG01S*
Die marking:	*-*
Die dimensions:	*4.3 mm x 4.8 mm*



SET Characterization of Parts for the ATV Project:

IRFY140 (2/5)

Bias Conditions
As per ATV/MMS/PR/FX/329.03 EADS fax dated 30/07/03

VDS =30V
VGS=-4V

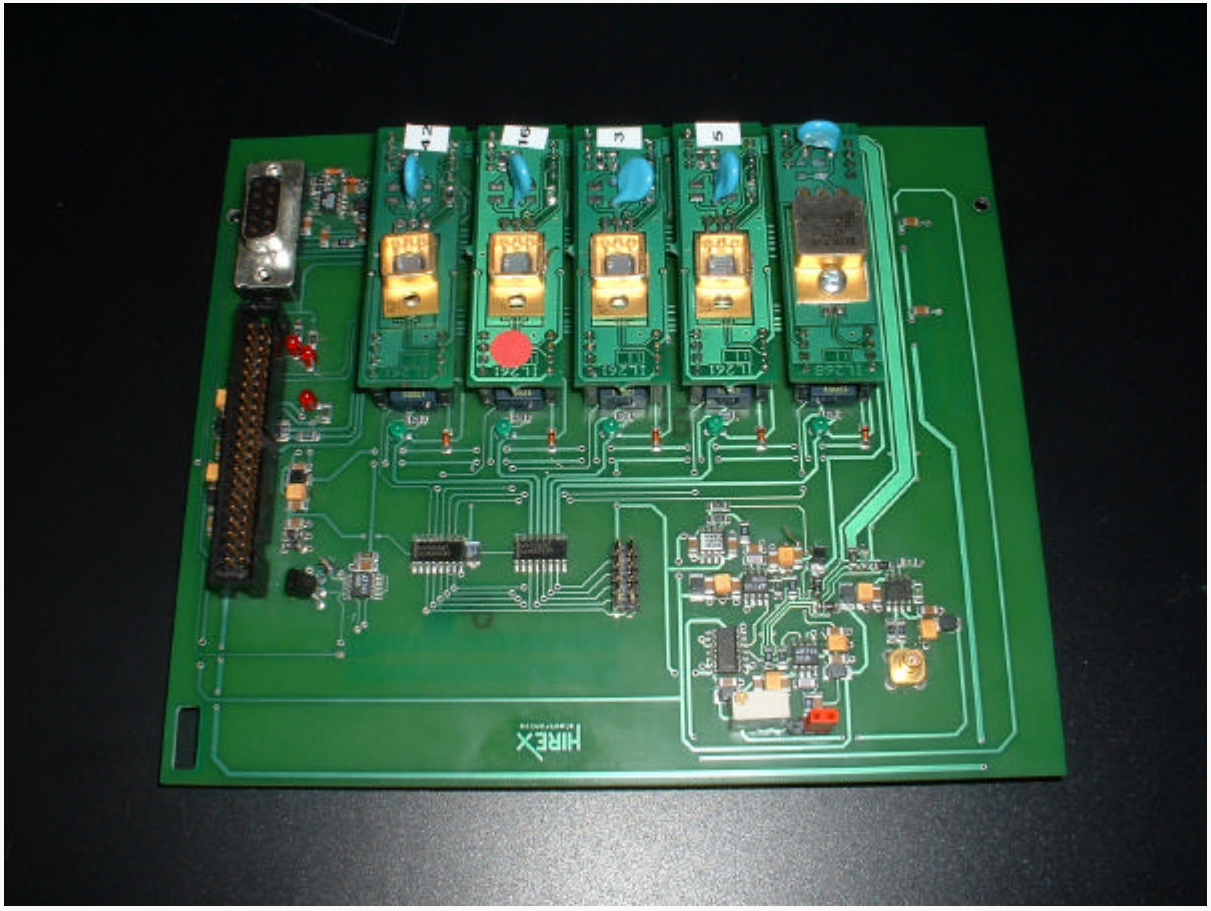
Test Set-up allows for detecting and counting:

SEB (non destructive burn-out by limiting the energy)
SEGR (gate current monitoring)

Upon completion of each run (beam off), device operation is tested at nominal specified VDS (100V)

SET Characterization of Parts for the ATV Project:

IRFY140 (3/5)



SET Characterization of Parts for the ATV Project:

IRFY140 (4/5)

BNL Tandem Van de Graaff accelerator 2004-01-17

Ion	**Energy** MeV	**LET(Si)** Mev/(mg/cm²)	**Range (Si)** µm
Br-81	279	37.45	36.09

SET Characterization of Parts for the ATV Project:

IRFY140 (5/5)

Beam data

Run	S/N	LET(Si)	Tilt	Roll	Time	Flux	Fluence	Dose	TotalDose
#	#	MeV.cm2/mg	deg	deg	sec	#/cm2/sec	#/cm2	RAD(Si)	RAD(Si)
1	5	37.45	0	0	581	9.16E+03	5.32E+06	3.01E+03	3.01E+03
2	3	37.45	0	0	578	8.65E+03	5.00E+06	3.01E+03	3.01E+03
3	3	37.45	0	0	586	8.54E+03	5.00E+06	3.01E+03	6.03E+03
4	3	37.45	0	0	443	1.18E+04	5.23E+06	3.01E+03	9.04E+03
5	5	37.45	0	0	406	1.23E+04	5.00E+06	3.02E+03	6.03E+03

IRFY140 results

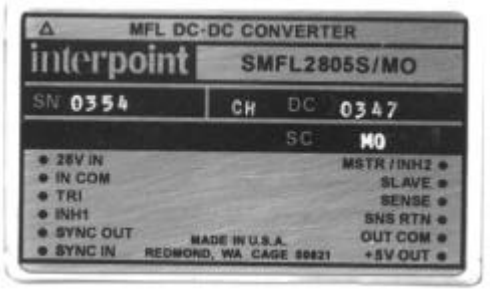
Run	S/N	LET(Si)	Fluence	Events	Events	Test Cond	Test Cond
#	#	MeV.cm2/mg	#/cm2	SEB	SEGR	Vds (V)	Vgs (V)
1	5	37.45	5.32E+06	0	0	30	-4
2	3	37.45	5.00E+06	0	0	30	-4
3	3	37.45	5.00E+06	0	0	40	-4
4	3	37.45	5.23E+06	0	0	50	-4
5	5	37.45	5.00E+06	0	0	50	-4

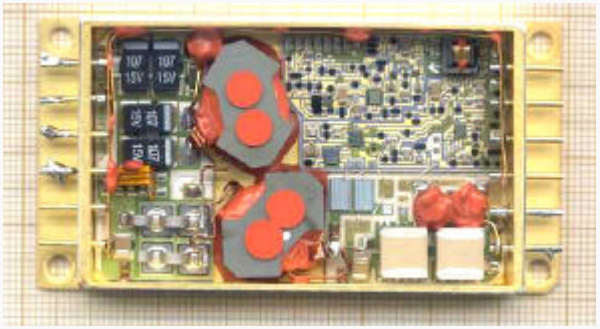
No SEB nor SEGR detected with ATV test conditions

SET Characterization of Parts for the ATV Project:

SMFL2805S (1/8)

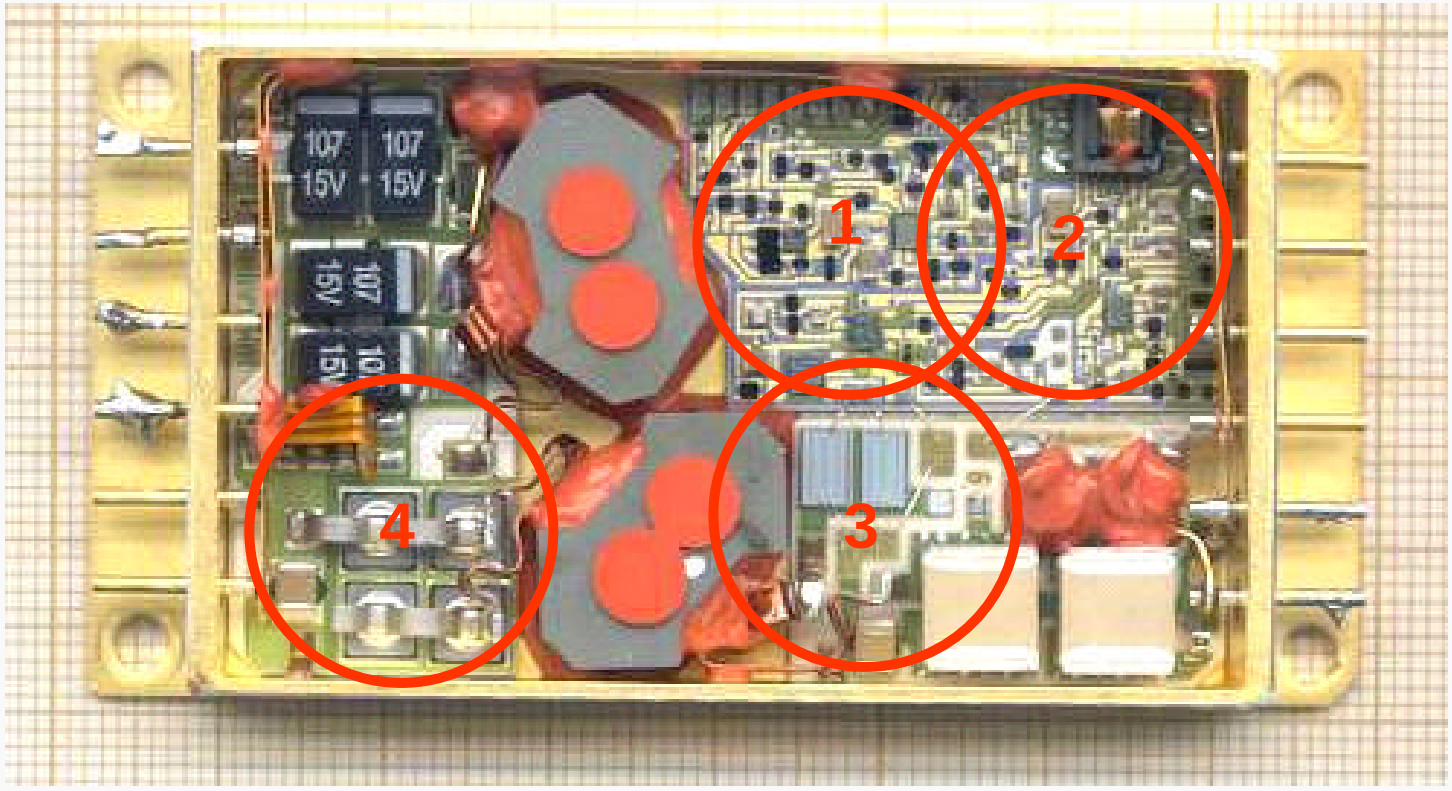
Part type:	*SMFL2805S*
Function:	*28V Input DC/DC Converter*
Manufacturer:	*Interpoint*
Package:	*Specific hermetic (U style)*
Quality Level:	*Hi-Rel (ATV flight parts)*
Date Code:	*0347*





SET Characterization of Parts for the ATV Project:

SMFL2805S (2/8)



Beam spot diameter is 23 mm

SET Characterization of Parts for the ATV Project:

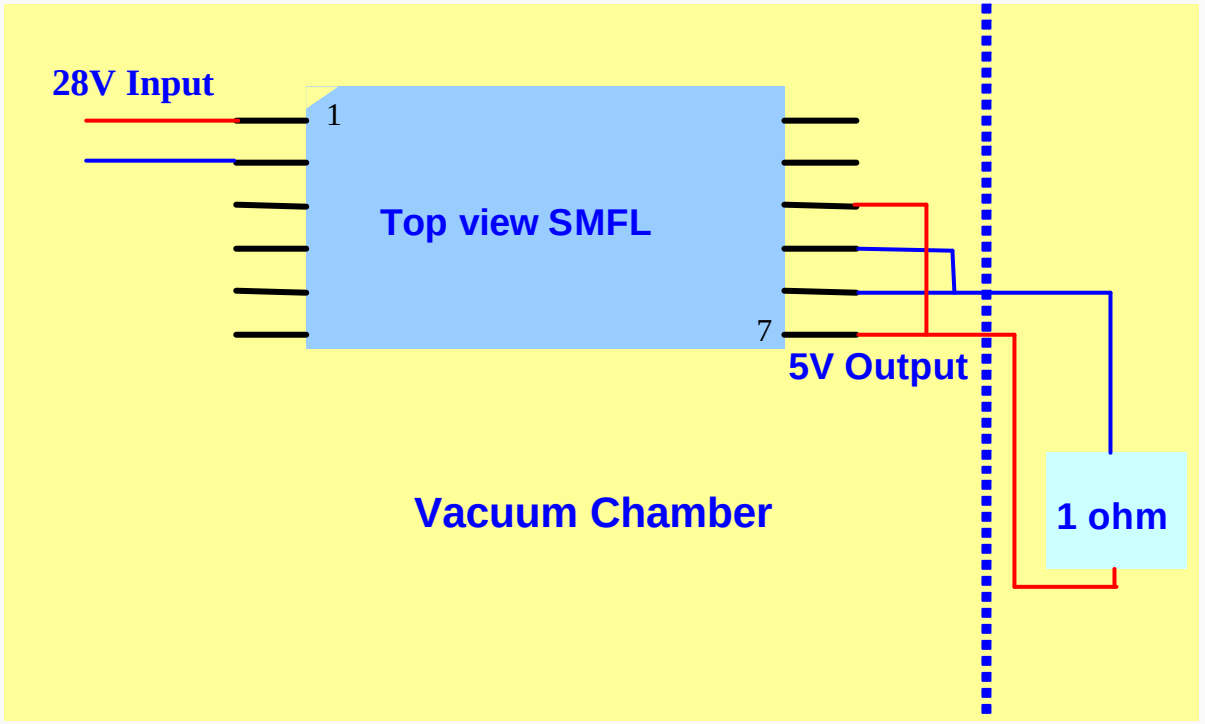
SMFL2805S (3/8)

Bias Conditions

As per ATV-RIBRE-DFX-0049-03, Astrium fax dated 14/02/03

Input voltage range: 28 VDC ± 4 VDC

Nominal output load: 25 W



SET Characterization of Parts for the ATV Project:

SMFL2805S (4/8)

UCL Cyclotron accelerator 2004 -03 -11

Ion	**Energy** MeV	**LET(Si)** Mev/(mg/cm²)	**Range (Si)** µm
Ne-20	78	5.85	45
Ar-40	150	14.1	42
Kr-84	316	34	43

SET Characterization of Parts for the ATV Project:

SMFL2805S (5/8)

RESULTS

Both positive and negative transient pulses were detected with a trigger level fixed to +/- 50 mV around DUT output voltage.

•Krypton (LET 34)	Both positive and negative events with exposed areas A1, A2 and A3
•Argon (LET 14)	Negative Events only with exposed areas A1 and A2
•Neon (LET 5.85)	No Event detected

SET waveforms

Negative Pulse:

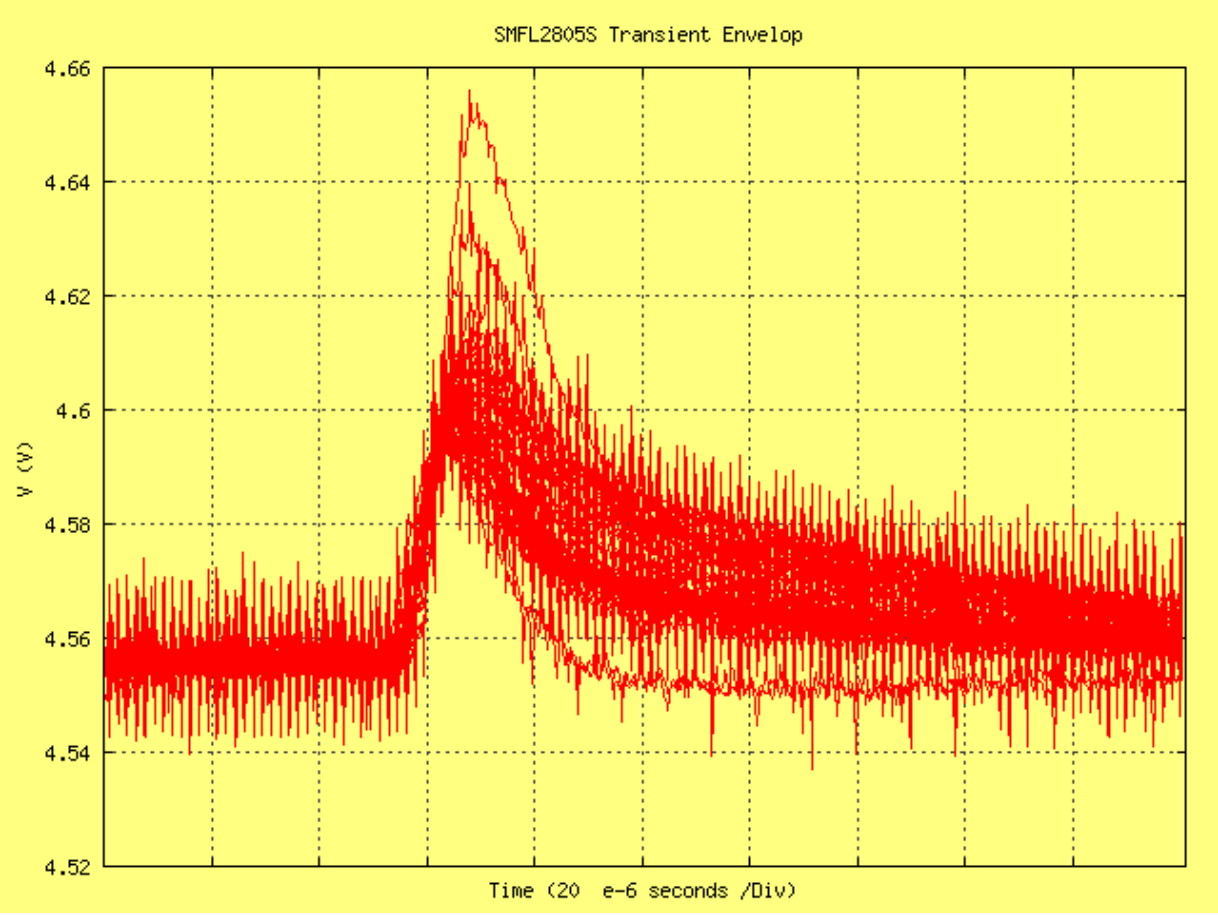
Worst case: amplitude 180mV, FWHM 20µs

Positive Pulse:

Worst case: amplitude 90mV, FWHM 50µs

SET Characterization of Parts for the ATV Project:

SMFL2805S (6/8)



Run 21

- Kr-84 ion
- LET of 34
- Fluence 5E5 #/cm²
- Exposed area A2
- 45 pulses recorded out of a total of 90 SETs

SET Characterization of Parts for the ATV Project:

SMFL2805S (7/8)

Run 22

- Kr-84 ion
- LET of 34
- Fluence 5E5 #/cm²
- Exposed area A2
- 104 pulses recorded out of a total of 208 SETs

SET Characterization of Parts for the ATV Project:

SMFL2805S (8/8)

SET Error X-section (cm²)				
		Kr (34)	Ar (14)	Ne (5.85)
A1	+50mV	1.98E-04	-	-
	-50mV	2.96E-04	5.00E-05	-
A2	+50mV	1.46E-04	-	-
	-50mV	3.58E-04	3.60E-05	-
A3	+50mV	3.43E-05	-	-
	-50mV	1.16E-04	-	-
A4	+50mV	-	-	-
	-50mV	-	-	-