CNES-ESA Final Presentation Days 2013
5th & 6th June ESA-ESTEC Newton Room

ENHANCED LOW-DOSE RATE SENSITIVITY ANALYSIS

Summary Test Results and Analysis on Bipolar Devices.

ESA CONTRACT Nº: 4000100717/2010/F/WE

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Agenda

- Project introduction.
- Bipolar parts.
  - List of candidates
  - Test conditions
  - Applicable Test Plans
  - Radiation facilities
  - Test results summary
- RADFET study was included in the same contract and managed by Tyndall.

Project Introduction

- Contract reference: 4000100717/2010/F/WE

"ENHANCED LOW-DOSE RATE SENSITIVITY ANALYSIS"

- Main Objetive of the contract:

  To test and analyse ELDRS sensitivity of bipolar linear devices and RadFETs, of relevance for the Galileo project and GNSS Evolution.

Candidates distribution by family

Function	Part Type
Converters	AD565
Voltage Reference	AD584 / REF02
Amplifier	LMH6702 / OP27 / OP470
Optocoupler	OLH249 / OLH449 / 66183-105
Comparators	PM139
Transistor	SOC5551
PWM	UC1525 / UC1825 / UC1843 / UC1846

List of candidates

MFR	PART TYPE	PART TYPE DESCRIPTION
MPC U	66183-105	Proton Radiation Tolerant 6Pin Optocoupler
AND U	AD565AT	12 BIT D/A Converter
AND U	AD584S	Pin programmable voltage reference
NSC U	LMH6702JF-QMLV	Linear, UltraLow Distorsion, Current Feedback, Wideband OP.Amplifier
ILK U	OLH249	Radiation Tolerant Phototransistor Hermetic Optocoupler
AND U	OP-27A	Low noise precision operational amplifier.
AND U	OP-470A	Very low noise, quad, operational amplifier.
AND U	PM139XMQMLR	Quad voltage comparator.
AND U	REF02AJQMLR	Precision reference +5-volt adjustable output.
STM F	SOC5551HRB	Transistors, High Voltage, NPN
TEX U	UC1525BJQMLV	Regulating Pulse Width Modulator
TEX U	UC1825J	Pulse Width Modulator Controller, Off-Line Current Mode
TEX U	UC1843	Current Mode Pulse Width Modulator
TEX U	UC1846J-SP	High Speed Pulse Width Modulator Controller

Test Conditions

Level of Interest	100 krad(Si)
Dose rates	Range of 36 rad(Si)/h versus Range of 360 rad(Si)/h
Energy	1.33/1.17 MeV
Radiation Source	Cobalt-60
Proposed Steps	5 krad, 10 krad, 20 krad, 35 krad, 50 krad, 100 krad, ann24h, ann168h
Bias distribution	50% bias and 50% unbiased A total of 20 samples were tested per part type.

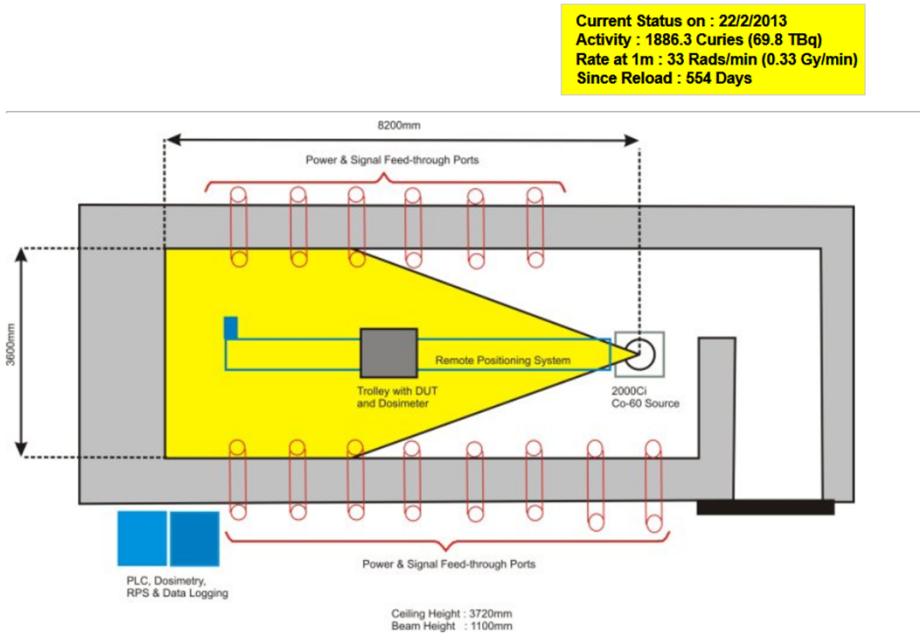
Test plans control

PART TYPE	COMPONENT NUMBER	PLAN REFERENCE	PACKAGE	APPROVED
AD565AT	5962-9689202VJA	ATGSP-RP-69 Iss:1	DIL-24	15/06/2011
OP-470A	5962R8856501VCA	ATGSP-RP-70 Iss:1	DIL-14	15/06/2011
AD584S	5962R3812801VGA	ATGSP-RP-71 Iss:1	CAN-8	18/05/2011
PM139XMQMLR	5962R8773902VDA	ATGSP-RP-72 Iss:1	FP-14	18/05/2011
REF02AJQMLR	5962R8551401VGA	ATGSP-RP-73 Iss:1	CAN-8	18/05/2011
OP-27A	5962R9468002VGA	ATGSP-RP-74 Iss:1	CAN-8	15/06/2011
OLH249	OLH249	ATGSP-RP-75 Iss:1	DIL-6	15/06/2011
OLH449	OLH449	ATGSP-RP-76 Iss:1	TO 5	15/06/2011
UC1843	UC1843-HiRel	ATGSP-RP-77 Iss:1	DIL-8	15/06/2011
UC1825J	5962-8768104VEA	ATGSP-RP-78 Iss:1	DIL-16	15/06/2011
SOC5551HRB	520101905FR	ATGSP-RP-79 Iss:1	LCC-3	18/05/2011
66183-105	66183-105	ATGSP-RP-80 Iss:1	LCC-6	15/06/2011
LMH6702JF-QMLV	5962F0254601VPA	ATGSP-RP-81 Iss:1	DIL-8	15/06/2011
UC1846J-SP	5962-8680603VEA	ATGSP-RP-82 Iss:1	DIL-16	18/05/2011
UC1525BJQMLV	5962-8951105VEA	ATGSP-RP-83 Iss:1	DIL-16	18/05/2011

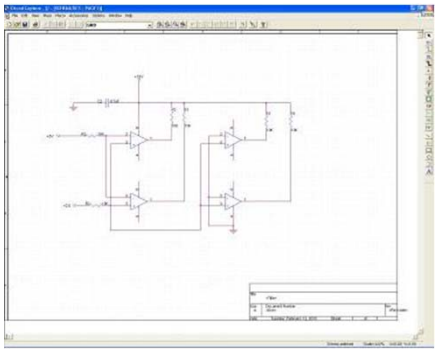
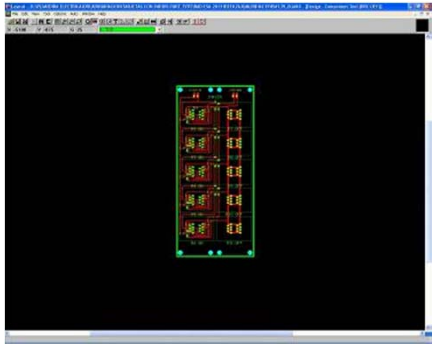
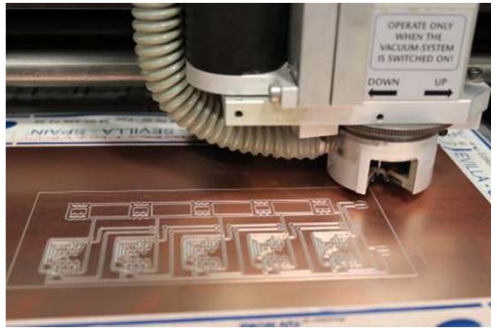
Irradiation Facilities

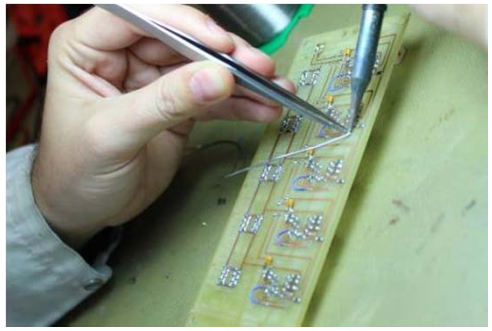
ALTER TECHNOLOGY has used two different facilities for performing the requested radiation tests

Estec Co-60 Facility

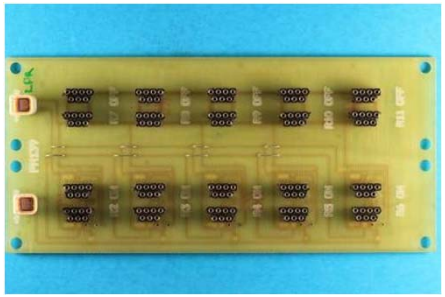
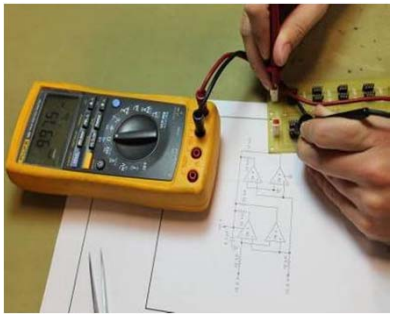


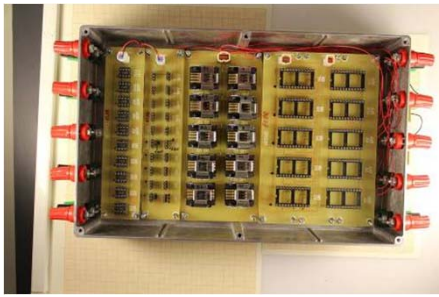
BIAS circuit and boards



We cover all the processes: circuit design, PCB design layout, PCB manufacturing, assembly and verification, installing adequate low insertion force sockets & SW test development for parameters monitoring



TID Execution

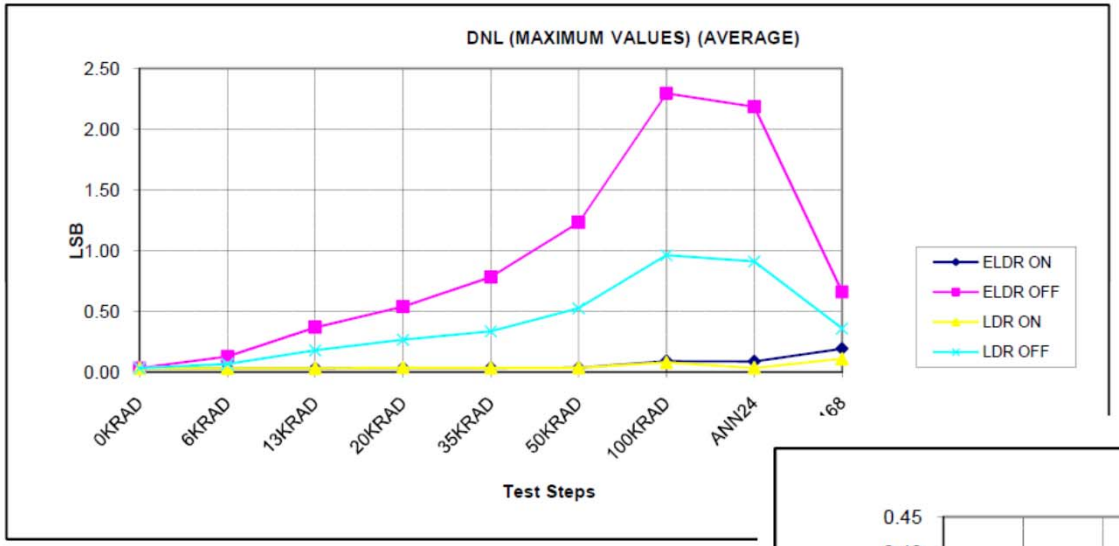
PART TYPE	PLAN REF.	REPORT REF.	FACILITY	STARTED DATE
AD565AT	ATGSP-RP-69 Iss:1	ATN-RR-012/2012	ESTEC	15/02/2012
OP-470A	ATGSP-RP-70 Iss:1	ATN-RR-008/2012	ESTEC	15/02/2012
AD584S	ATGSP-RP-71 Iss:1	ATN-RR-005/2012	ESTEC	15/02/2012
PM139XMQMLR	ATGSP-RP-72 Iss:1	ATN-RR-011/2012	ESTEC	15/02/2012
REF02AJQMLR	ATGSP-RP-73 Iss:1	ATN-RR-007/2012	ESTEC	15/02/2012
OP-27A	ATGSP-RP-74 Iss:1	ATN-RR-006/2012	ESTEC	15/02/2012
OLH249	ATGSP-RP-75 Iss:1	ATN-RR-002/2012	ESTEC	15/02/2012
OLH449	ATGSP-RP-76 Iss:1	ATN-RR-003/2012	ESTEC	15/02/2012
UC1843	ATGSP-RP-77 Iss:1	ATN-RR-009/2012	ESTEC	15/02/2012
UC1825J	ATGSP-RP-78 Iss:1	HRX/TID/1030	UCL	21/02/2012
SOC5551HRB	ATGSP-RP-79 Iss:1	ATN-RR-001/2012	ESTEC	15/02/2012
66183-105	ATGSP-RP-80 Iss:1	ATN-RR-004/2012	ESTEC	15/02/2012
LMH6702JF-QMLV	ATGSP-RP-81 Iss:1	HRX/TID/1028-9	UCL	06/03/2012
UC1846J-SP	ATGSP-RP-82 Iss:1	ATN-RR-010/2012	ESTEC	15/02/2012
UC1525BJQMLV	ATGSP-RP-83 Iss:1	HRX/TID/1032-3	UCL	11/06/2012

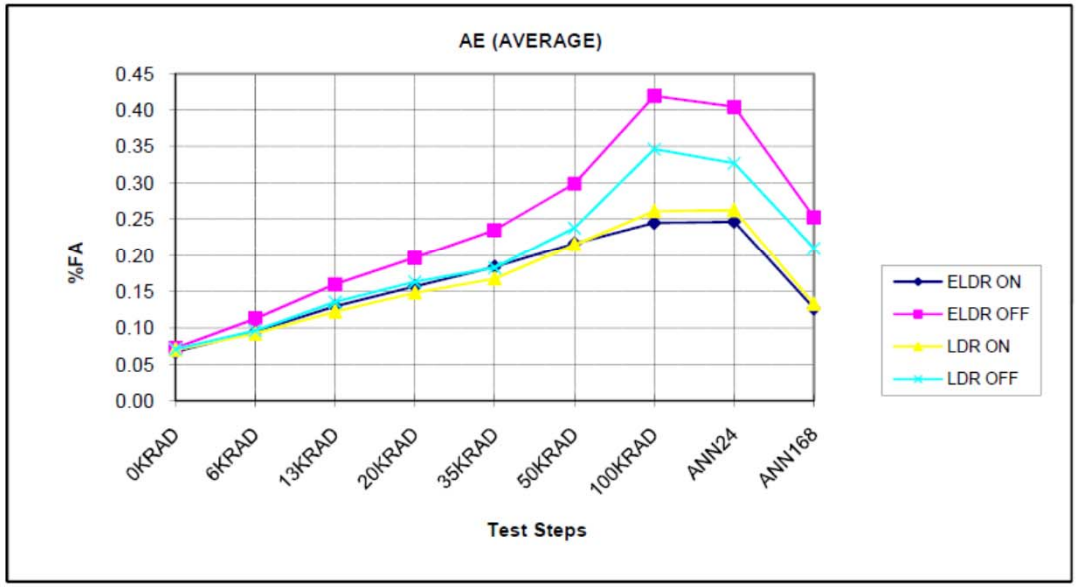
Test results summary

Function	**Converters**
Part type	**AD565**
The AD565A is fast 12-bit digital-to-analog converters that incorporate the latest advances in analog circuit design to achieve high speeds at low cost The wide output compliance range of the AD565A is ideally suited for fast, low noise, accurate voltage output configurations without an output amplifier.	
Parameters	RA, DNL, AE, VOS, BPZE, VREF, IOUT_UNI, IOUT_BIP, PSRR1, PSRR2, ICC, IEE, IIH, IIL
Conclusions 	The results obtained during the irradiation test show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the DNL and AE that starts to be out of limits at 13krad step and AE that starts to be out of limits at 30krad step.**

Test results summary

AD565 plots examples.





Test results summary

Function	**Voltage reference**
Part type	**AD584**

The AD584 is an eight-terminal precision voltage reference offering pin-programmable selection of four popular output voltages: 10.000 V, 7.500 V, 5.000 V and 2.500 V. Other output voltages, above, below or between the four standard outputs, are available by the addition of external resistors. Input voltage may vary between 4.5 and 30 volts

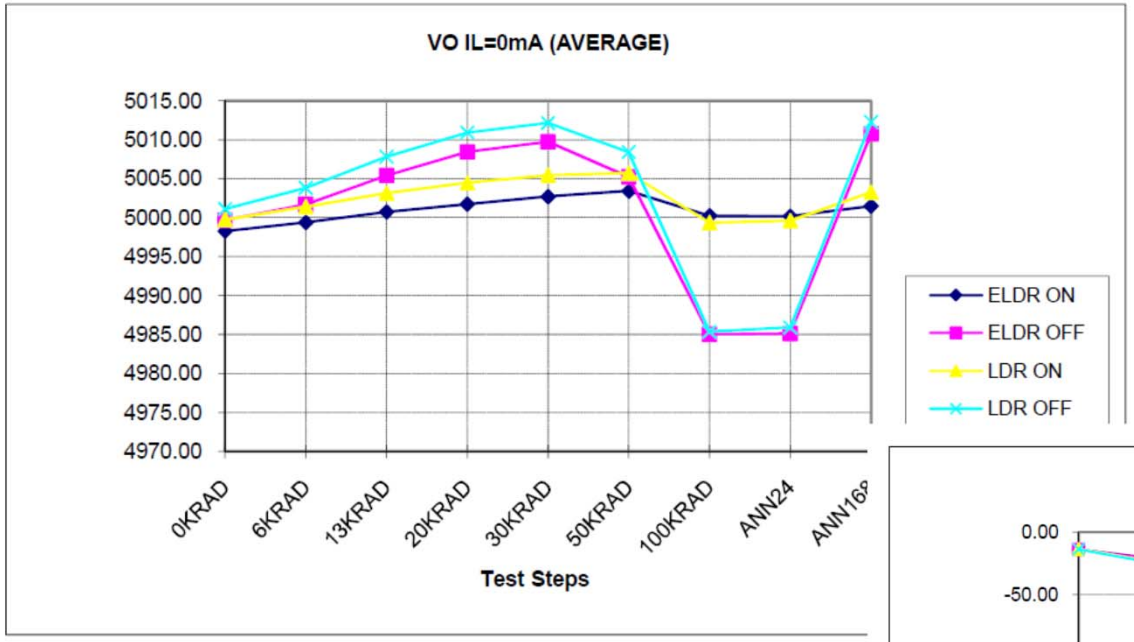
Parameters	ICC, VOUT1, VOUT2, VOUT3, VOUT4, VRLINE1, VRLINE2, VRLOAD1, VRLOAD2, VRLOAD3, VRLOAD4, IOS
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the VOUT's, VRLINE's and VRLOAD's parameters.** **-VOUT's: The results show a higher degradation in the samples biased OFF than the biased ON. The degradation in the samples tested at ELDR is higher than the samples tested at LDR.** **-VRLINE's: The results show a higher degradation in the samples biased OFF than the biased ON. The degradation in the samples tested at ELDR is higher than the samples tested at LDR. In the VRLINE1 and VRLINE 2 parameters are within limits during all irradiation steps except at ANN 168h step, where the obtained values are out of limits in the samples tested at ELDR.** **-VRLOAD's: The results show that this parameter doesn't have a high deviation during all irradiation steps except at the ANN 168h step. Even In the VRLOAD1 and VRLOAD2, there are some values that are out of limits in the samples biased OFF at LDR.** For the rest of the parameters, clear different behaviors between ELDR, LDR, On and Off biased parts are not observed

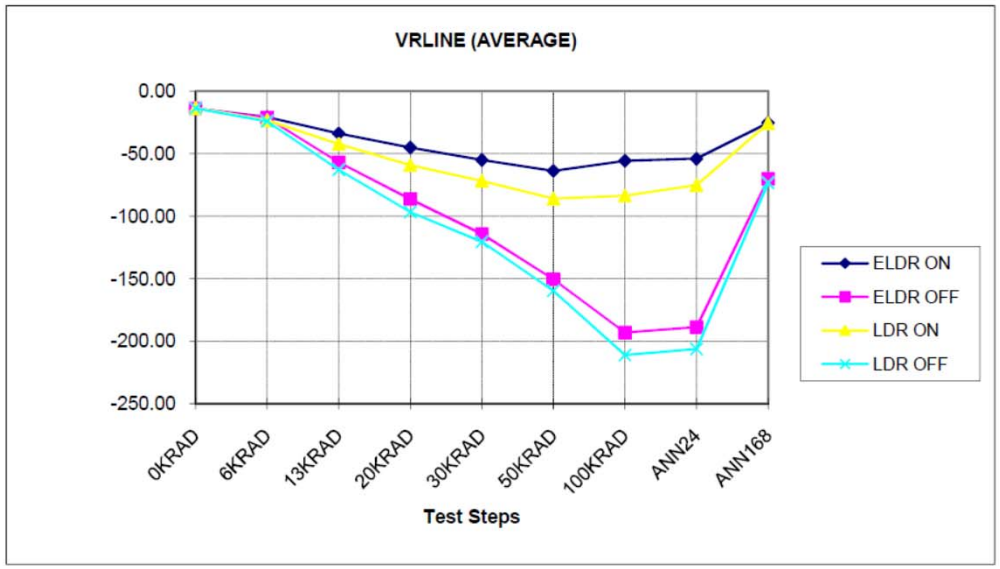
Test results summary

Function	**Voltage references**
Part type	**REF02**
The REF0x series of precision voltage references provide a stable 10.0 V, 5.0 V, or 2.5 V output with minimal change in response to variations in supply voltage, ambient temperature or load conditions.	
Parameters	ISY, VO, IOS, LD reg, LN reg.
Conclusions 	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the Vo and VRLINE. The Vo parameter starts to be out of limits at the 13krad step and VRLINE parameter, at the 20krad step. The VRLOAD doesn't show a high deviation vs total dose, although the serial number R2 is out of limits at the ANN168 step. The samples tend to recover their initial values during the annealing process**. In general, the samples show a higher degradation in the samples biased OFF that the samples biased ON.

Test results summary

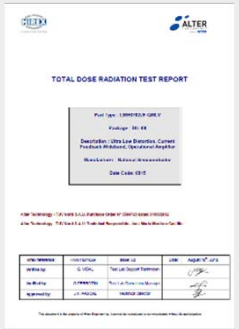
REF02 plot example.





Test results summary

Function	**Amplifiers**
Part type	**LMH6702**
The LMH6702 is a very wideband, DC coupled monolithic operational amplifier designed specifically for wide dynamic range systems requiring exceptional signal fidelity. Benefit- ing from National's current feedback architecture, the LMH6702 offers unity gain stability at exceptional speed without need for external compensation	
Parameters	IBN, IBI, VIO, CMRR, ICC±, PSRR±
Conclusions	**All parameters remained within specification limits all along testing.**


TOTAL DOSE RADIATION TEST REPORT

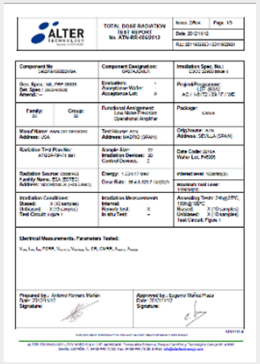
Test results summary

Function	**Amplifiers**
Part type	**OP27**

The OP27 precision operational amplifier combines the low offset and drift of the OP07 with both high speed and low noise. Offsets down to 25 µV and drift of 0.6 µV/°C maximum make the OP27 ideal for precision instrumentation applications

Parameters VOS, IOS, IIB, PSRR, VOUT(1), VOUT(2), IS, SR, CMRR, AVO(1), AVO(2)

Conclusions (1/2)



The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when ested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si).

The most affected parameters are the VIO, IIB's, VOUT's, IS, SR and AVO's parameters.

-VIO: starts to be out of limits at 100krad step in the LDR test. The results show that the samples biased OFF in the LDR test are the samples with the highest degradation.

-IIB: starts to be out of limits at 20krad step in the samples biased OFF. The results show that the samples biased OFF have a higher degradation than the samples biased ON. The samples submitted to the LDR test have a higher degradation than the samples submitted to the ELDR test.

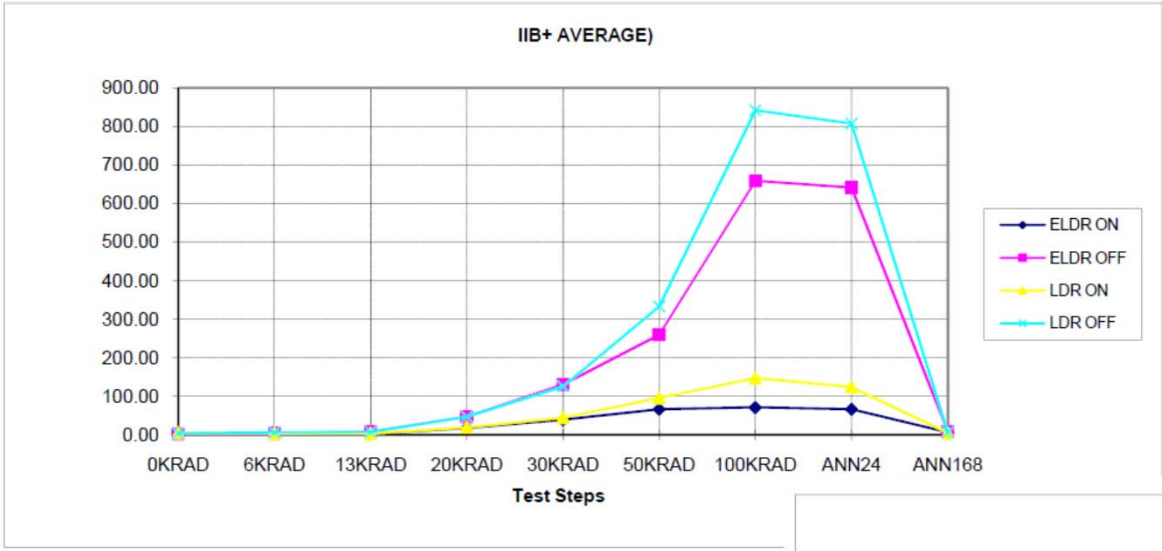
-VOUT's: although the results obtained in this parameter show that it is sensitive to the cumulative radiation dose rate all the Vout parameters are within limits during all irradiation steps. In general, the samples biased OFF have a higher degradation than the samples biased ON

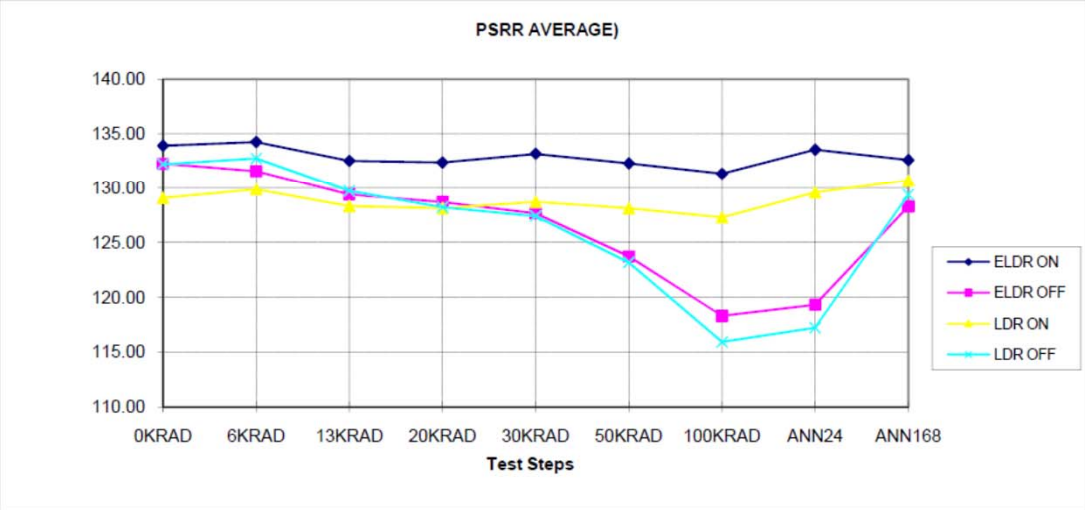
Test results summary

Function	**Amplifiers**
Part type	**OP27**
The OP27 precision operational amplifier combines the low offset and drift of the OP07 with both high speed and low noise. Offsets down to 25 µV and drift of 0.6 µV/°C maximum make the OP27 ideal for precision instrumentation applications	
Parameters	VOS, IOS, IIB, PSRR, VOUT(1), VOUT(2), IS, SR, CMRR, AVO(1), AVO(2)
Conclusions (2/2)	-IS: although the results obtained in this parameter show that it is sensitive to the cumulative radiation dose rate, the IS parameter is within limits during all irradiation steps. In general, the samples biased OFF have a higher degradation than the samples biased ON. -SR: starts to be out of limits at 13 krad step in the samples biased OFF. The samples biased OFF have a higher degradation than the samples biased ON. -AVO's: the serial numbers R7 and R8 start to be out of limits in the AVO (2) parameter in the LDR test at 100krad step. Along the lines of the other parameters, the samples biased OFF show a higher degradation than the samples biased ON. All parameters tend to recover its initial values during the annealing process. For the rest of the parameters, clearly different behaviors between ELDR, LDR, On and Off biased parts are not observed.

Test results summary

OP27 plots examples





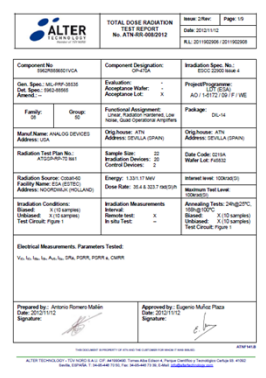
Test results summary

Function	**Amplifiers**
Part type	**OP470**

The OP470 is a high-performance monolithic quad operational amplifier with exceptionally low voltage noise, 5 nV/÷Hz at 1 kHz max, offering comparable performance to ADI's industry standard OP27.

Parameters VIO, IIO, IIB±, IIB-, AVS, IS±, SR±, PSRR, PSRR ±, CMRR

Conclusions (1/2)



The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si).

The most affected parameters are the IIB±, IIO, AVS, SR± and PSRR.

-IIB±: starts to be out of limits at 20krad step in the ELDR test. The results show that the samples biased OFF have a higher degradation than the samples biased ON. The samples submitted to the LDR test have a higher degradation than the samples submitted to the ELDR test.

-IIO: this parameter starts to be out of limits at 50krad step in the ELDR test. The results show that the samples biased OFF have a higher degradation than the samples biased ON. For this parameter clearly different behaviours between ELDR and LDR test are not observed.

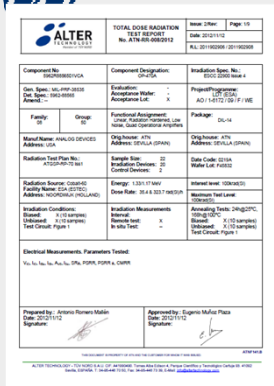
-AVS: this parameter starts to be out of limits at 13krad step in the samples biased OF in the ELDR and LDR test. The results show that the samples biased OFF have a higher degradation than the samples biased ON. For this parameter clearly different behaviour between ELDR and LDR test are not observed.

Test results summary

Function	**Amplifiers**
Part type	**OP470**

The OP470 is a high-performance monolithic quad operational amplifier with exceptionally low voltage noise, 5 nV/÷Hz at 1 kHz max, offering comparable performance to ADI's industry standard OP27.

Parameters	VIO, IIO, IIB±, IIB-, AVS, IS±, SR±, PSRR, PSRR ±, CMRR
Conclusions (2/2)	-SR±: the obtained results show that the SR+ starts to be out of limits at 50krad step in the samples biased OFF. The samples biased ON are within limits during all irradiation steps. The SR- is out of limits only at the 100krad step in the samples biased OFF. The samples biased ON are within limits during all irradiation steps. The results show that the samples biased OFF have a higher degradation than the samples biased ON and the samples submitted to the LDR test have a higher degradation that the samples submitted to the ELDR test. -PSRR: the worst results have been obtained in the PSRR- parameter that starts to be out of limits at 13krad step. Along the lines of the other parameters, the samples biased OFF have a higher degradation than the samples Biased ON. All parameters tend to recover its initial values during the annealing process. The rest of the parameters remain within limits during all irradiation steps.

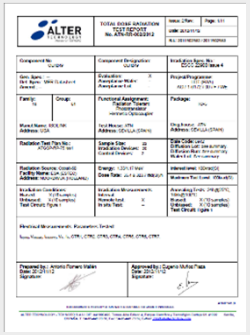


Test results summary

Function	**Optocouplers**
Part type	**OLH249**

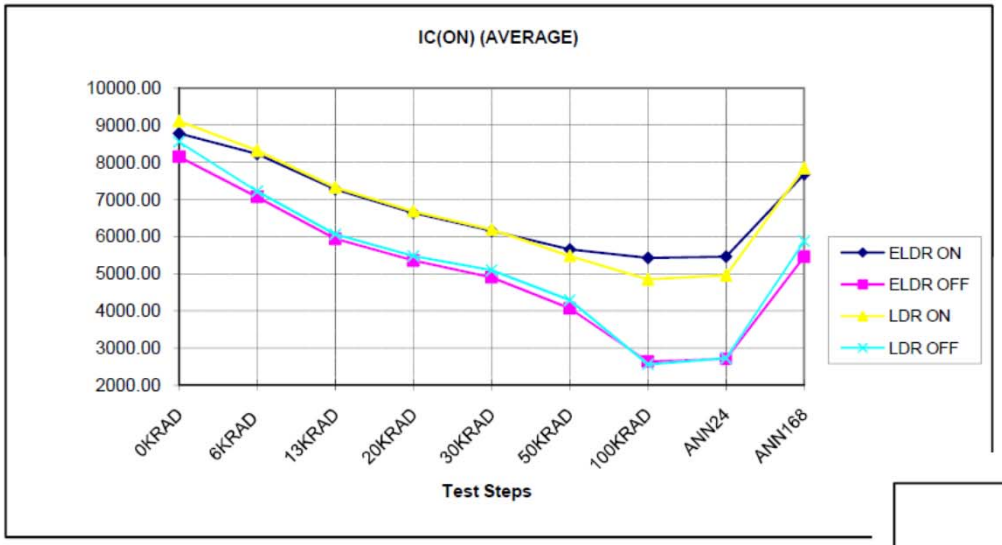
The OLH249 is designed especially for hi-rel applications requiring optical isolation in radiation environments such as gamma , neutron and proton radiation with high current transfer ratio and low saturation Vce. Each optocoupler consists of a light emitting diode and a NPN silicon phototransistor electrically isolated but optically coupled inside a hermetic TO - 5 package. Electrical parameters are similar to the JEDEC registered 4N49 optocoupler but with much better CTR degradation characteristics

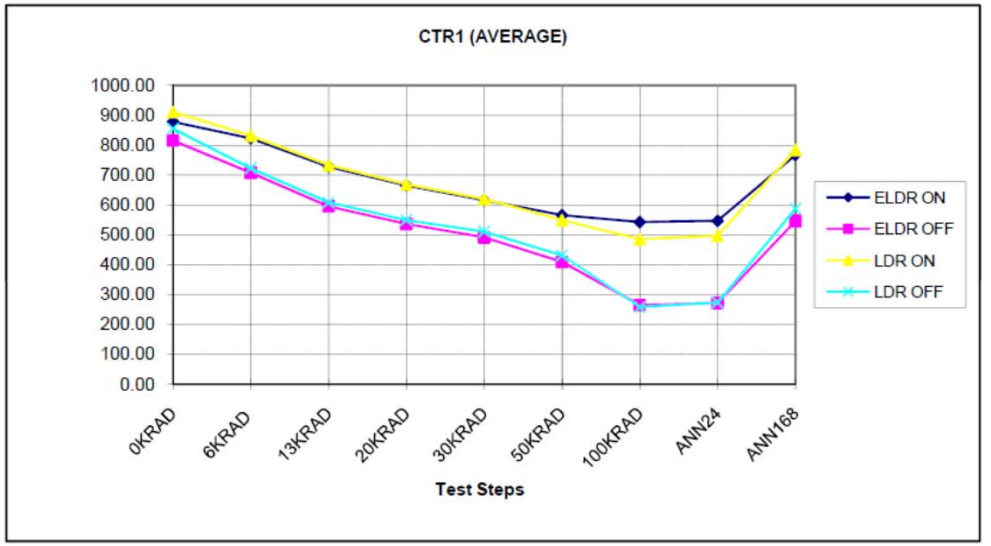
Parameters	IC(ON), VCE(sat), ICE(OFF), VF, IR, CTR1, CTR2, CTR3, CTR4, CTR5, CTR6, CTR7.
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the IC(ON), VCE(SAT) and the CTR's but they remain within specification limits.** **The samples tend to recover their initial values during the annealing process.** -IC(ON): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards. -VCE(SAT): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 100krad onwards. CTR's: The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards. For the rest of the parameters, it is not observed a clear differentiate behaviour between ELDR, LDR, On and Off biased parts



Test results summary

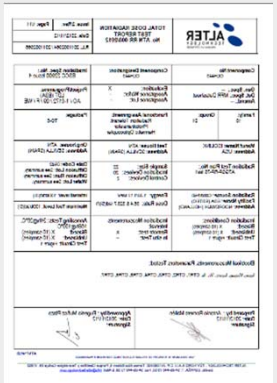
OLH 249 plots examples





Test results summary

Function	**Optocouplers**
Part type	**OLH449**
Parameters	IC(ON), VCE(sat), IC(OFF), VF, IR, CTR1, CTR2, CTR3, CTR4, CTR5, CTR6, CTR7.
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si) **The most affected parameters are the IC(ON), VCE(SAT) and the CTR's. The IC(ON) parameter starts to be out of limits at the 35krad step.** The other parameters remain within specification limits. The samples tend to recover their initial values during the annealing process. -IC(ON): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards. -VCE(SAT): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 100krad onwards. CTR's: The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards. For the rest of the parameters, it is not observed a clear differentiate behaviour between ELDR, LDR, On and Off biased parts

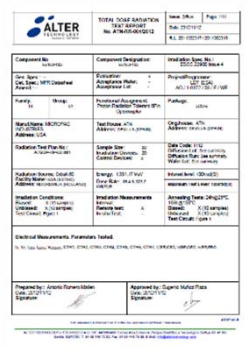


Test results summary

Function	**Optocouplers**
Part type	**66183-105**

The 66183 is a single channel device electrically similar to the 4N49. This product has been designed to be more tolerant to proton radiation. The 66183 optocoupler is packaged in a hermetically sealed 6 pin leadless chip carrier (LCC).

Parameters	IR, VF, ICEO, IC(ON), VCE(SAT), CTR1, CTR2, CTR3, CTR4, CTR5, CTR6, CTR7, V(BR)CBO, V(BR)CEO, V(BR)EBO.
Conclusions (1/2)	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the IC(ON), VCE(SAT), CTR's, VCBO, and VCEO(BR). The IC(ON) parameter starts to be out of limits at 50krad step for LDR and at 100krad step for ELDR. The other parameters remain within specification limits. The samples tend to recover their initial values during the annealing process.** -IC(ON): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed at 100krad and annealing 24h steps. -VCE(SAT): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed at 100krad step.



Test results summary

Function	**Optocouplers**
Part type	**66183-105**
The 66183 is a single channel device electrically similar to the 4N49. This product has been designed to be more tolerant to proton radiation. The 66183 optocoupler is packaged in a hermetically sealed 6 pin leadless chip carrier (LCC).	
Parameters	IR, VF, ICEO, IC(ON), VCE(SAT), CTR1, CTR2, CTR3, CTR4, CTR5, CTR6, CTR7, V(BR)CBO, V(BR)CEO, V(BR)EBO.
Conclusions (2/2)	-CTR's: The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed at 100krad and annealing 24h steps. -VCBO: The results show a higher degradation in the samples biased ON at ELDR. -VCEO(BR): The results show a higher degradation in the samples biased OFF than the biased ON. For the rest of the parameters, it is not observed a clear differentiate behaviour between ELDR, LDR, On and Off biased parts

Test results summary

Function	Comparators
Part type	**PM139**

The PM139 has four independent voltage comparators, each with precision DC specifications. Low offset voltage, bias current, power consumption and output saturation voltage are offered in a design that features single power supply operation. The input voltage range includes ground for convenient single supply operation. The 2mA power supply current, independent of supply voltage - coupled with the single supply operation, makes this comparator ideal for low power applications. Open collector outputs allow maximum applications flexibility

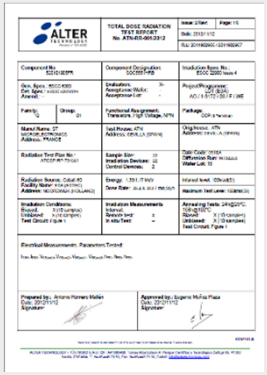
Parameters	VIO, IIO, IIB, AV, IOL, ICC, CMRR, VSAT, PSRR, ISINK.
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). The most affected parameters are the IB±, IIO and AV. The IB+ and the IIO are out of limits at the 100krad and ANN24h due to the fact that the operational #4 in the serial number 5 (ON) at ELDR test, shows an anomalous behaviour in respect to the other samples. This sample was measured several times obtaining the same values. Consequently we can discard contact problems or wrong measurements. If we do not take into account the values obtained in the operational #4 in the serial number 5 (ON), **all the parameters remain under their limits during the whole irradiation test.** All the parameters tend to recover their initial values during the annealing process. In general the samples biased ON show a higher degradation than the samples biased OFF.

Test results summary

Function	**Transistors**
Part type	**SO5551HR**

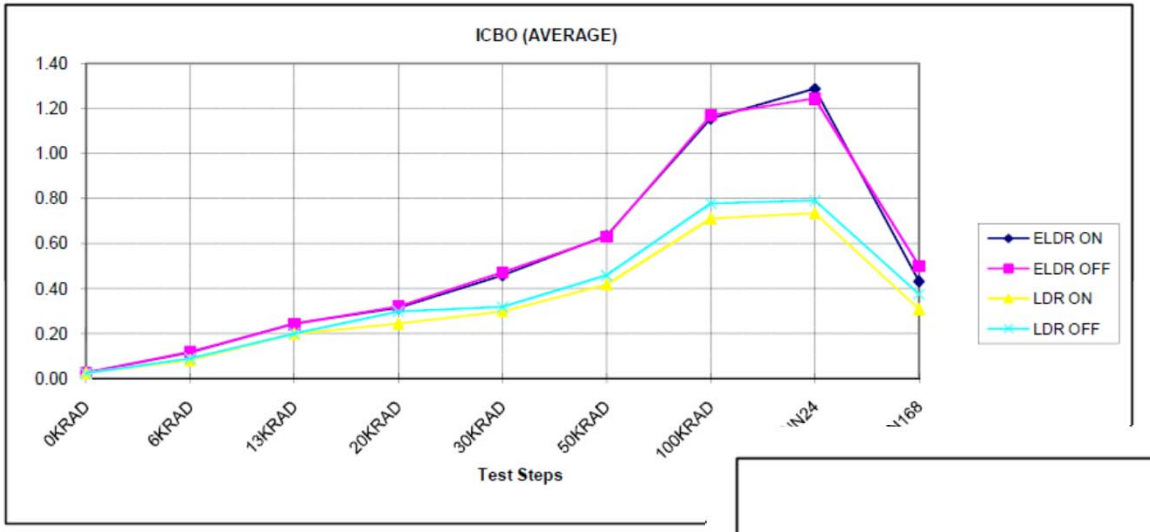
The 2N5551HR is a silicon planar epitaxial NPN transistor in LCC-3 packages. It is specifically designed for aerospace Hi-Rel applications and ESCC qualified according to the 5201-019 specification

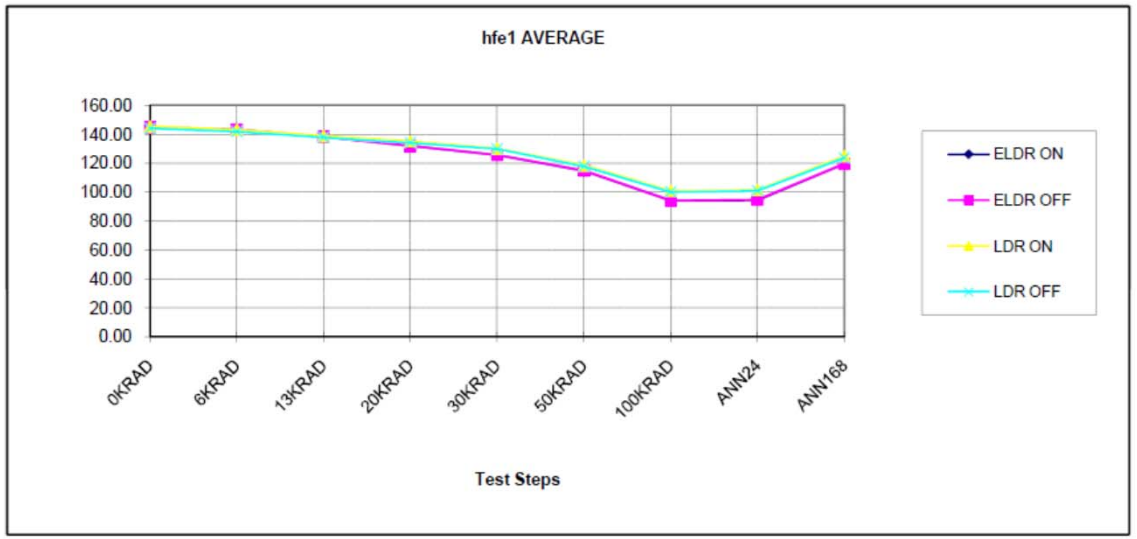
Parameters	ICBO, IEBO, VCE(sat)1, VCE(sat)2, VBE(sat)1, VBE(sat)2, hFE1, hFE2, hFE3.
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameters are the ICBO, VCE(SAT)1,2 and hFE's but they remain within specification limits.** The samples tend to recover their initial values during the annealing process. -ICBO: The results show a higher degradation in the samples tested at LDR than the samples tested at ELDR. -VCE(SAT)1,2: The results show a higher degradation in the samples biased OFF than the samples biased ON. The degradation in the samples biased OFF at LDR is similar to the degradation in the samples biased ON at ELDR in the 50krad and 100krad steps. For the rest of the parameters, it is not observed a clear differentiate behaviour between ELDR, LDR, On and Off biased parts



Test results summary

SO5551HR Plots examples





Test results summary

Function	**PWM**
Part type	**UC1525A**

The UC1525A series of pulse width modulator integrated circuits are designed to offer improved performance and lowered external parts count when used in designing all types of switching power supplies. The on-chip +5.1V reference is trimmed to ±1% and the input common-mode range of the error amplifier includes the reference voltage, eliminating external resistors.

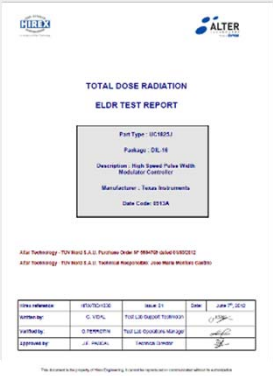
Parameters	VREF, VRLINE, VRLOAD, IOS, VIO, IIB±, IIO, AVOL, VOL1, VOH1, CMRR, PSRR, ISS, VSS, ISD, VTH, VOL2 A, VOL3 A, VOL2 B, VOL3 B, VOH2 A, VOH3 A, VOH2 B, VOH3 B, VUL, IS.
Conclusions	**All parameters remain within specification limits.**

Test results summary

Function	**PWM**
Part type	**UC1825**

The UC1825 family of PWM control ICs is optimized for high frequency switched mode power supply applications. Particular care was given to minimizing propagation delays through the comparators and logic circuitry while maximizing bandwidth and slew rate of the error amplifier. This controller is designed for use in either current-mode or voltage mode systems with the capability for input voltage feed-forward.

Parameters	ICC, ISTART, VREF, VRLINE, VRLOAD, ISC, F0, ΔFO/ΔV, VIM, VIV, VOS, IOS, IIB±, AVOL, CMRR, PSRR, IO(SINK), IO(SRC), VOH1, VOL1, SR±, IBRAMP, DC(RANGE) A, DC(RANGE) B, VTH, ICHG, IDCHG, VOL2(1) A, VOL2(1) B, VOL2(2) A, VOL2(2) B, VOH2(1) A, VOH2(1) B, VOH2(2) A, VOH2(2) B, VSTART, VHYS.
Conclusions	**All parameters remained within specification limits all along testing.**


TOTAL DOSE RADIATION

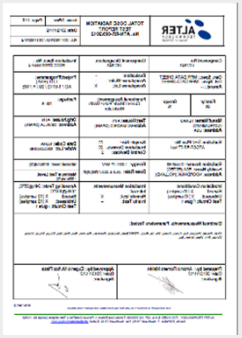
ELDR TEST REPORT

Test results summary

Function	**PWM**
Part type	**UC1843**

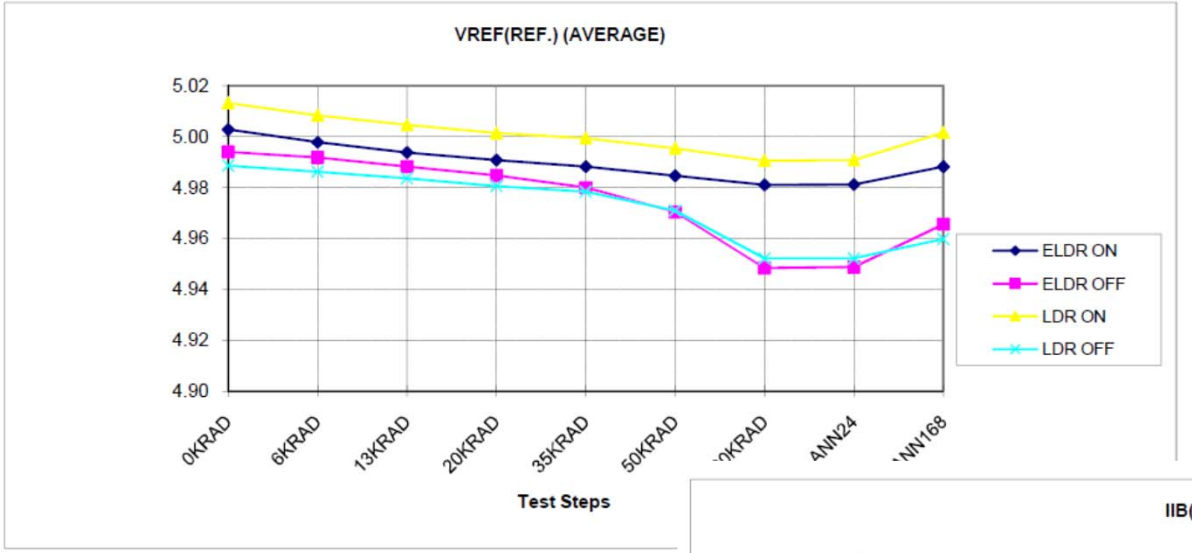
The UC1842/3/4/5 family of control devices provides the necessary features to implement off-line or dc-to-dc fixed frequency current mode control schemes with a minimal external parts count. Internally implemented circuits include under-voltage lockout featuring start up current less than 1 mA, a precision reference trimmed for accuracy at the error amp input, logic to insure latched operation, a PWM comparator which also provides current limit control, and a totem pole output stage designed to source or sink high peak current. The output stage, suitable for driving N-Channel MOSFETs, is low in the off state.

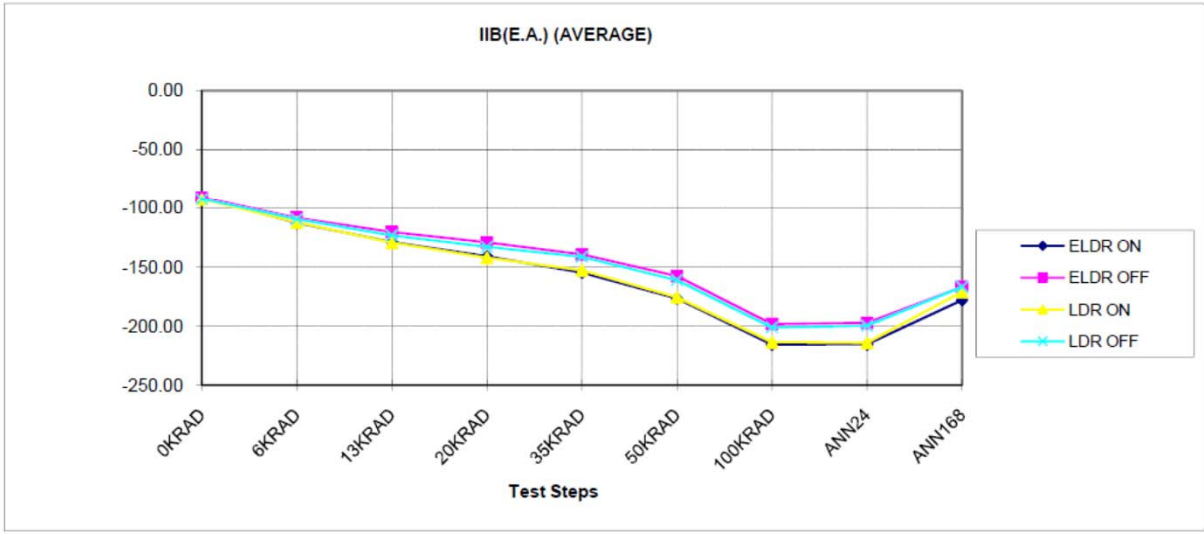
Parameters	VREF, VRLINE, VRLOAD, IOS, FOSC1, FOSC2, VIN, IIB, AVOL, PSRR ISINK, ISOURCE, VOH1PIN1, VOL1PIN1, AV2, VIN2, IIB2, VOL2A, VOL2B, VOH2A, VOH2B, VTH, VMIN, ISTART, ICC.
Conclusions	The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **The most affected parameter is the VREF that starts to be out of limits at 50krad step. The degradation observed in the samples biased OFF is higher than the observed in the samples biased ON.** **In the IIB parameter of the Error Amplifier it is observed a great deviation with regard to the initial values, but the parameter remains under limits during all irradiation test.** **In general, the samples biased OFF show a higher degradation than the samples biased ON.**



Test results summary

UC1843 plots examples





Test results summary

Function	**PWM**
Part type	**UC1846**

The UC1846 family of control ICs provides all of the necessary features to implement fixed frequency, current mode control schemes while maintaining a minimum external parts count. The superior performance of this technique can be measured in improved line regulation, enhanced load response characteristics, and a simpler, easier-to-design control loop. Topological advantages include inherent pulse-by-pulse current limiting capability, automatic symmetry correction for push-pull converters, and the ability to parallel "power modules" while maintaining equal current sharing.

Parameters	VO, VRLINE, VRLOAD, IOS, fOSC, ΔfOSC, VSOH, VSOL, ISYNC(1), VIO(1), IIB(1), IIO(1), AVS, CMRR, PSRR, ISYNC(2), ISOURCE, VOH(1), VOL(1), AV, VIDIFF, VIO(2), CMRR(2), PSRR(2), IIB(2), IIO(2), VCLO, IIB(3), VTH, VOL(2), VOL(3), VOH(2), VOH(3), +VSU-TH, ICC.
Conclusions	The results obtained during the irradiation test, show that this lot is slightly sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si). **However, all parameters are within limits during the whole irradiation test.**

Some conclusions

- The parts off biased normally have higher radiation degradation than the biased ones.
- There are types in which the ELDR suppose an increase of degradation, others the standard LDR is the worst condition, but also there are several cases in which no big differences are observed between both test conditions.
- To have a complete overview, please check ESCIES which will show the complete radiation test reports.

THANK YOU FOR YOUR ATTENTION

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