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DESTINATAIRE(s)	**Société(s)**	**N° ☎ du télécopieur :** **Ville :**
A. GRASS	CODECHAMP	05.55.67.68.59

Notre référence : DGA/T/AQ/CA/ 189

Dear Sir,

Here are the results of the AD976 A/D converter under Cobalt 60 irradiation.
This is the answer of actions taken during the ROSETTA meeting in CNES (18 March 99, Redactor : D. Black MMS UK).

First action

5 parts have been sent by CODECHAMP to CNES (date code 9723, narrow DIL).
3 of them have been tested under NASA condition (V input = 2.5V DC, R/C= 5V) during irradiation and in the range used by CODECHAMP i.e. 5Vcc analog input and 12 bits resolution. The dose rate was 100 rad/hour..

Conclusion :

- detailed results are given in the appendix,
- **parts are still in specification for CODECHAMP application after 66.5 Krad**

Second action

Technologica has sent 5 samples parts to CNES the 20th of May for radiation testing purpose (date code ??? wide DIL). These parts came from the FM lot. Due to the packaging, a new test board has been developed by CNES and irradiation test have been started the 12th of July. Final results (dose rate is 200 rad/hour) are expected for the 25th of July.

Best regards,

F. PRESSECQ

Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA

Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA

Présentation du composant

L' AD976ABN est un convertisseur analogique-numérique 16 bits faible consommation, haute vitesse. Sa vitesse de conversion est de 200 KSPS. Dans sa configuration minimum, une simple alimentation 5 Volts suffit.
C'est un composant de technologie CMOS.

Calendrier :

Du 23 Mars 1999 au 21 Avril 1999 à 100 rad / heure.

Sérialisation :

Le test porte sur un lot de 3 pièces identifiées p1, p2 et p3 et une pièce témoin.

Datecode : 9723

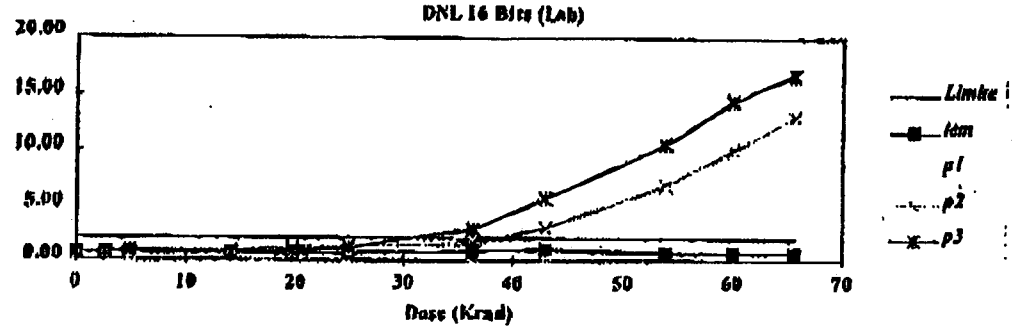
Conditions de test : Voir schéma en annexe

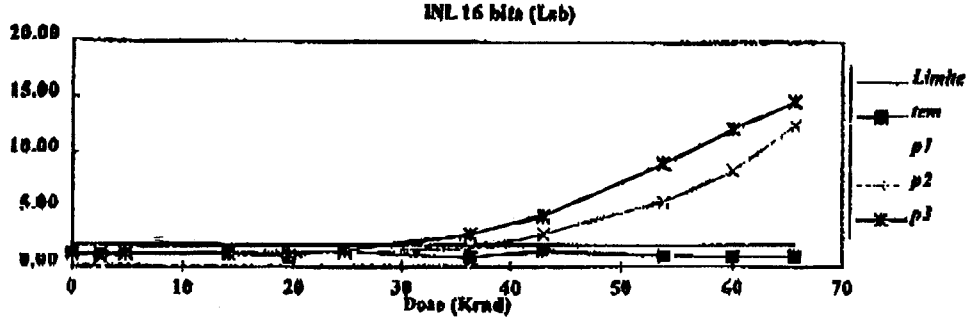
Tableau de synthèse :

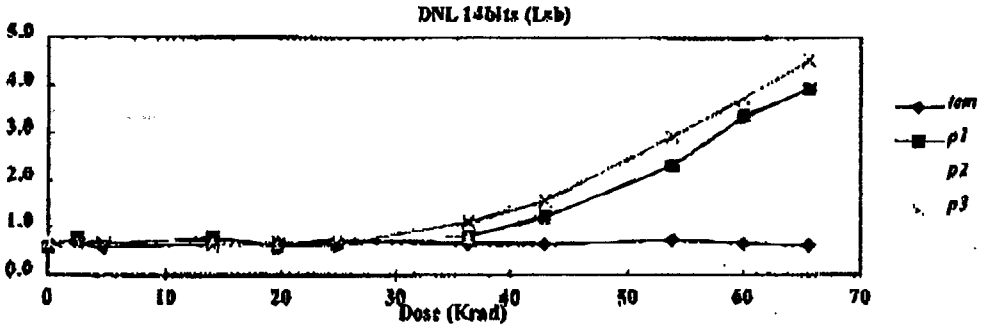
	Initial			24.6Krad			36.8Krad			49.2 Krad			
Paramètres	Min	Max	Moy	Min	Max	Moy	Min	Max	Moy	Min	Max	Moy	Spécifications
R/C VIHL	1.43	1.46	1.44	1.35	1.45	1.39	1.28	1.46	1.35	1.19	1.44	1.31	Max 2.00V
R/C VILH	1.441	1.473	1.46	1.355	1.453	1.39	1.273	1.461	1.35	1.223	1.438	1.31	Min 0.80V
R/C IIH(nA)	1.35	1.5	1.40	5.1	8.3	6.41	2.35	3.9	2.84	0.3	0.55	0.39	+/- 10000nA
R/C IIL(nA)	-0.65	-0.5	-0.58	-2.7	-2	-2.31	-23.8	-1.25	-8.7	10.5	0.05	5.65	+/- 10000nA
Busy VoH, Ioh=-1mA	4.56	4.58	4.5675	4.54	4.59	4.56	4.53	4.59	4.553	4.51	4.59	4.535	Min 4.0
Dout VoH, Ioh=-1mA	4.54	4.58	4.555	4.53	4.58	4.555	4.53	4.58	4.55	4.53	4.57	4.547	Min 4.0
Dout VoL, IoL=1,6mA	0.109	0.133	0.119	0.106	0.112	0.109	0.106	0.116	0.111	0.107	0.122	0.116	Max 0.400V
t1 (ns)	28.4	29.8	29.15	28.5	30.7	29.75	28.4	31.2	30.075	27.4	32.1	30.125	Max 50ns
t11 (ns)	3.705	3.742	3.724	3.692	3.708	3.698	3.686	3.703	3.695	3.695	3.757	3.725	Max 4.000us
t3 (ns)	57.2	59.7	58.375	55	59.7	57.775	54.9	60.7	58.45	56.2	65.6	62.1	Max 83us
t4+t3 (ns)	3.887	3.923	3.902	3.883	3.905	3.894	3.877	3.893	3.885	3.884	3.94	3.919	Max 4.000us
Idigi (mA), Vdd= 5.0 V	2.2	2.224	2.211	2.192	2.321	2.280	2.265	2.961	2.647	2.285	3.592	2.832	Max 5.000mA
Iana (mA), Vdda=5.0V	9.425	10.088	9.667	9.44	9.815	9.544	8.43	9.458	9.163	8.951	9.605	9.284	Max 12.000mA
DNL 16 bits (Lsb)	0.637	0.731	0.681	0.717	1.334	1.077	0.776	2.918	1.885	0.744	16.836	11.408	Max 2.0 Lsb
INL 16 bits (Lsb)	0.864	1.198	1.071	1.132	1.469	1.392	0.861	2.869	1.942	1.006	18.446	11.671	Max 2.0 Lsb
DNL 12 bits (Lsb)	0.134	0.164	0.146	0.15	0.219	0.174	0.148	0.28	0.21125	0.15	3.512	0.9115	
INL 12 Bits (Lsb)	0.11	0.191	0.134	0.112	0.152	0.129	0.165	0.196	0.1795	0.148	0.913	0.64625	
DNL 14 Bits(Lsb)	0.587	0.7	0.644	0.647	0.773	0.699	0.66	1.105	0.837	0.603	4.538	3.13975	
INL 14 Bits (Lsb)	0.437	0.568	0.507	0.567	0.719	0.661	0.484	0.981	0.69325	0.658	3.651	2.73575	
Zero Offset Error (Lsb)	15.087	31.26	22.942	22.102	32.731	28.041	22.517	34.175	28.533	31.09	35.85	32.735	+/- 66 Lsb

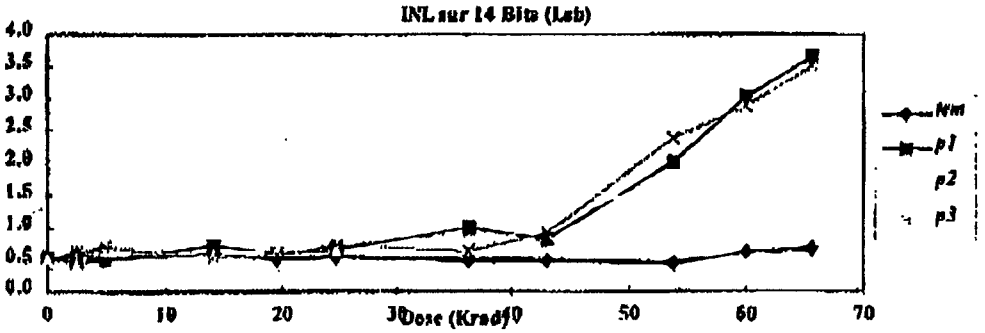
Légende :
t1 : convert pulse width
t11 : previous data valid after R/C low(ns)
t3 : busy delay from R/C low (ns)
t4+t3 : busy high from R/C low (us)

Graphes des paramètres dérivants :

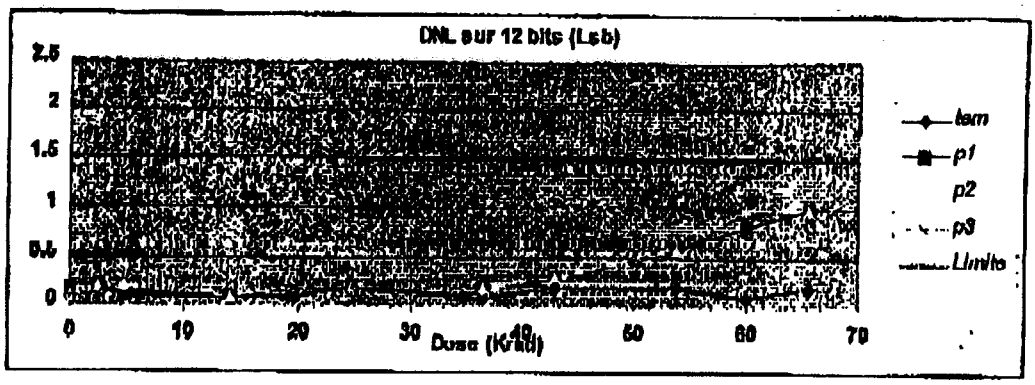


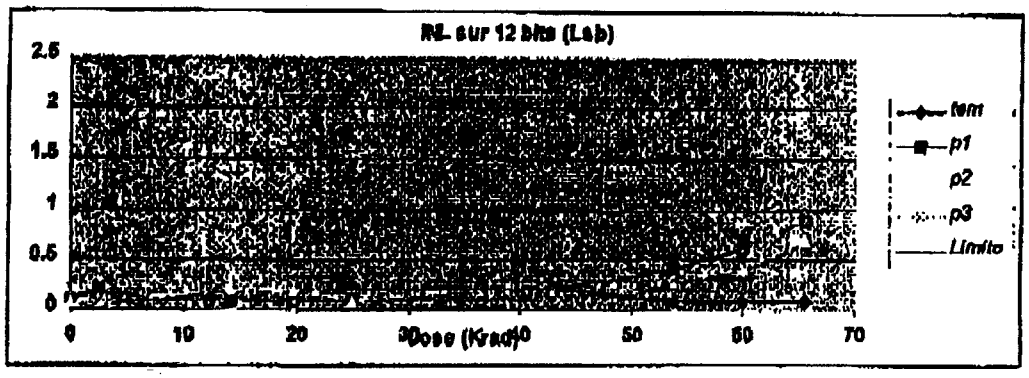






Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA





Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA

Tableaux des mesures

R/C Vih (V)

Spécification Max=2.00V

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	1.44	1.45	1.45	1.44	1.36	1.45	1.46	1.43	1.46	1.44	1.44
p1ac	1.44	1.42	1.42	1.37	1.36	1.35	1.32	1.30	1.26	1.26	1.19
p2ac	1.46	1.43	1.41	1.40	1.39	1.38	1.34	1.31	1.32	1.30	1.32
p3ac	1.43	1.41	1.41	1.37	1.37	1.36	1.28	1.31	1.28	1.29	1.30

R/C Vil (V)

Spécification Min= 0.80V

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	1.45	1.45	1.45	1.44	1.38	1.45	1.46	1.43	1.45	1.44	1.44
p1ac	1.45	1.42	1.42	1.37	1.36	1.36	1.32	1.28	1.25	1.24	1.22
p2ac	1.47	1.42	1.41	1.39	1.39	1.38	1.35	1.31	1.32	1.30	1.29
p3ac	1.44	1.40	1.40	1.37	1.37	1.37	1.27	1.31	1.27	1.28	1.28

R/C Iih (nA)

Spécification Min= -10000.00 Max= 10000.00 nA

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	1.35	1.95	1.15	1.10	1.15	8.30	3.90	0.35	0.90	0.40	0.30
p1ac	1.50	2.10	1.85	1.15	1.30	7.15	2.55	0.45	0.90	0.45	0.35
p2ac	1.35	2.20	1.70	1.15	1.20	5.10	2.35	0.55	0.90	0.50	0.35
p3ac	1.40	1.90	1.20	1.15	1.30	5.10	2.55	0.55	1.10	0.55	0.55

R/C Iil (nA)

Spécification Min= -10000.000 Max= 10000.000 nA

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	-0.65	-0.85	-1.05	-1.05	-1.20	-2.45	-1.25	0.00	-0.25	-0.10	0.05
p1ac	-0.50	-1.00	-0.85	-0.95	-0.95	-2.70	-5.30	-6.85	-10.05	-6.85	-10.05
p2ac	-0.50	-1.25	-0.60	-1.05	-0.85	-2.00	-4.45	-8.80	-4.65	-9.40	-5.10
p3ac	-0.65	-1.30	-1.05	-1.10	-0.85	-2.10	-23.80	-8.25	-9.15	-7.75	-7.50

Busy Voh Isource=-1mA (V)

Spécification Min= 4.000 Max= 5.000 V

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	4.58	4.59	4.59	4.58	4.54	4.59	4.59	4.58	4.59	4.58	4.59
p1ac	4.56	4.56	4.56	4.55	4.54	4.55	4.53	4.53	4.52	4.51	4.51
p2ac	4.57	4.57	4.57	4.57	4.56	4.56	4.55	4.54	4.54	4.53	4.53
p3ac	4.56	4.56	4.56	4.56	4.54	4.54	4.54	4.53	4.52	4.51	4.51

Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA

Dout Voh Isource=-1mA (V)

Spécification Min= 4.000 Max= 5.000 V

	0	2.6	4.8	14.1	19.6	24.8	36.6	42.9	53.8	60	65.6
Témoin	4.55	4.57	4.56	4.56	4.52	4.58	4.58	4.57	4.57	4.57	4.57
p1ac	4.55	4.55	4.55	4.53	4.53	4.54	4.53	4.51	4.53	4.50	4.53
p2ac	4.58	4.59	4.56	4.57	4.56	4.57	4.56	4.54	4.55	4.53	4.56
p3ac	4.54	4.55	4.55	4.54	4.53	4.53	4.53	4.50	4.53	4.49	4.53

Dout Vol Isink=1.6mA (V)

Spécification Max= 0.400 V

	0	2.6	4.8	14.1	19.6	24.8	36.6	42.9	53.8	60	65.6
Témoin	0.124	0.109	0.123	0.120	0.114	0.106	0.106	0.108	0.109	0.109	0.107
p1ac	0.113	0.112	0.116	0.121	0.115	0.111	0.116	0.116	0.117	0.120	0.119
p2ac	0.109	0.106	0.120	0.109	0.112	0.108	0.111	0.112	0.114	0.115	0.116
p3ac	0.133	0.122	0.115	0.112	0.114	0.112	0.112	0.117	0.118	0.122	0.122

t1=convert pulse width (ns)

Spécification Max= 60.0 ns

	0	2.6	4.8	14.1	19.6	24.8	36.6	42.9	53.8	60	65.6
Témoin	28.9	28.9	28.9	28.6	31.0	28.5	28.4	27.1	27.3	27.4	27.4
p1ac	29.5	29.7	29.8	30.0	30.8	30.5	31.1	30.2	30.6	31.5	31.1
p2ac	28.4	28.3	28.4	28.9	29.4	29.3	29.6	28.3	29.0	29.8	29.9
p3ac	29.8	29.9	29.9	30.2	31.0	30.7	31.2	30.3	30.9	31.8	32.1

t11=previous data valid after R/C low (us)

Spécification Max= 4.000 us

	0	2.6	4.8	14.1	19.6	24.8	36.6	42.9	53.8	60	65.6
Témoin	3.705	3.707	3.697	3.686	3.702	3.692	3.686	3.683	3.697	3.690	3.695
p1ac	3.725	3.713	3.695	3.682	3.696	3.692	3.703	3.708	3.707	3.719	3.722
p2ac	3.742	3.723	3.701	3.702	3.707	3.708	3.702	3.697	3.711	3.726	3.726
p3ac	3.724	3.693	3.693	3.680	3.699	3.701	3.688	3.716	3.723	3.746	3.757

t3=busy delay from R/C low (ns)

Spécification Max= 83.0 ns

	0	2.6	4.8	14.1	19.6	24.8	36.6	42.9	53.8	60	65.6
Témoin	57.2	56.4	56.5	55.9	60.8	55.0	54.9	56.0	56.2	56.5	56.2
p1ac	59.1	58.5	58.4	58.9	60.6	59.2	60.7	62.3	62.9	64.6	65.6
p2ac	57.5	56.1	56.1	57.2	58.1	57.2	58.0	59.6	60.4	62.0	61.7
p3ac	59.7	58.6	58.5	59.4	60.5	59.7	60.2	62.2	63.2	65.0	64.9

Rapport de mesures en doses cumulées de l'AD976 suivant spéc. d'irradiation NASA

t4+t3=busy hight from R/C low (us)

Spécification Max= 4.000 us

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	3.887	3.887	3.888	3.877	3.890	3.883	3.878	3.872	3.887	3.879	3.884
p1ac	3.898	3.888	3.887	3.877	3.890	3.889	3.891	3.898	3.896	3.914	3.938
p2ac	3.923	3.900	3.894	3.898	3.904	3.905	3.893	3.890	3.906	3.914	3.916
p3ac	3.899	3.882	3.885	3.878	3.894	3.898	3.877	3.903	3.912	3.940	3.940

Idigi supply current (mA)

Spécification Max= 6.000 mA

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	2.200	2.251	2.314	2.703	2.191	2.321	2.265	2.514	2.243	2.670	2.285
p1ac	2.213	2.140	2.274	2.112	2.010	2.192	2.542	2.823	3.542	2.942	3.592
p2ac	2.224	2.509	2.740	2.118	2.034	2.287	2.820	3.736	2.801	3.272	2.703
p3ac	2.206	2.174	2.440	2.252	2.062	2.321	2.961	2.983	3.509	2.604	2.748

Iana supply current (mA)

Spécification Max= 12.000 mA

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
Témoin	9.425	9.604	9.661	9.339	9.489	9.477	9.389	9.159	9.576	9.387	9.372
p1ac	9.618	9.469	9.529	9.211	9.563	9.440	9.378	9.262	8.980	9.272	8.951
p2ac	10.088	9.629	9.556	9.688	9.940	9.815	9.458	9.250	9.513	9.467	9.605
p3ac	9.538	9.351	9.332	9.175	9.558	9.442	8.430	9.114	8.893	9.320	9.209

Calcul de la DNL (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	0.7	0.7	0.7	0.7	0.6	0.7	0.8	1.1	0.6	0.6	0.7
p1	0.6	0.6	0.7	0.8	0.8	1.1	2.3	3.8	8.9	12.2	15.0
p2	0.7	0.7	0.7	0.9	1.1	1.3	1.6	3.0	6.9	10.1	13.0
p3	0.7	0.6	0.8	0.7	0.9	1.2	2.9	5.8	10.6	14.4	16.8

Calcul de l'INL (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	1.2	1.0	0.9	1.3	0.9	1.2	0.9	1.4	1.0	1.0	1.0
p1	0.9	1.1	0.9	1.2	1.1	1.1	2.4	3.9	10.5	14.9	18.4
p2	1.2	1.1	1.2	1.1	1.4	1.3	1.7	2.9	5.9	8.5	12.6
p3	1.1	1.0	1.2	1.1	1.1	1.5	2.9	4.5	9.2	12.3	14.7

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Calcul de la DNL 12 bits (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2
p1	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.3	0.6	0.8	1.0
p2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.3	0.6	1.0	1.0
p3	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	1.0	1.3	1.5

Calcul de l'INL 12 bits (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
p1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.6	0.9
p2	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3	0.4	0.7
p3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.6	0.9

Calcul de la DNL 14 bits (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.6	0.6
p1	0.6	0.8	0.6	0.8	0.6	0.6	0.8	1.2	2.3	3.3	3.9
p2	0.7	0.6	0.8	0.6	0.7	0.8	0.8	1.0	2.0	2.7	3.5
p3	0.6	0.7	0.7	0.6	0.7	0.7	1.1	1.6	2.9	3.7	4.5

Calcul de l'INL 14 bits (LSB)

Spécification Max= 2.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.5	0.4	0.6	0.7
p1	0.6	0.5	0.5	0.7	0.6	0.7	1.0	0.8	2.0	3.0	3.7
p2	0.5	0.4	0.6	0.6	0.7	0.7	0.7	1.1	1.8	2.3	3.1
p3	0.4	0.6	0.7	0.6	0.6	0.7	0.6	0.9	2.4	2.9	3.5

zero offset error (LSB)

Spécification Min= -66.0 Max= 66.0 LSB

	0	2.5	4.8	14.1	19.6	24.8	36.5	42.9	53.8	60	65.6
tem	31.3	30.7	30.6	30.8	31.4	31.4	31.2	31.5	31.4	31.6	31.1
p1	15.1	16.7	17.3	18.8	21.1	22.1	22.5	22.3	20.4	27.6	32.0
p2	16.1	17.9	18.3	22.9	24.8	25.9	26.2	25.8	29.3	31.8	32.0
p3	29.3	29.6	30.9	32.3	32.4	32.7	34.2	34.0	34.4	34.3	35.9

Annexes

Annexe1 :

Matériel

- Testeur IMS ATS200. Calibration valable jusqu'au 18 Décembre 1998
- Connecteur P36.
- Deux unités source/moniteur Keithley 2400 - IEEE.
- Alimentation HP6626A
- Banc de test VXI :
  - Module de synchronisation VXI/Testeur IMS.
  - Générateur Bruel&kjaer type 3105
- Station de travail.
- Logiciel de test sequenTEST@.

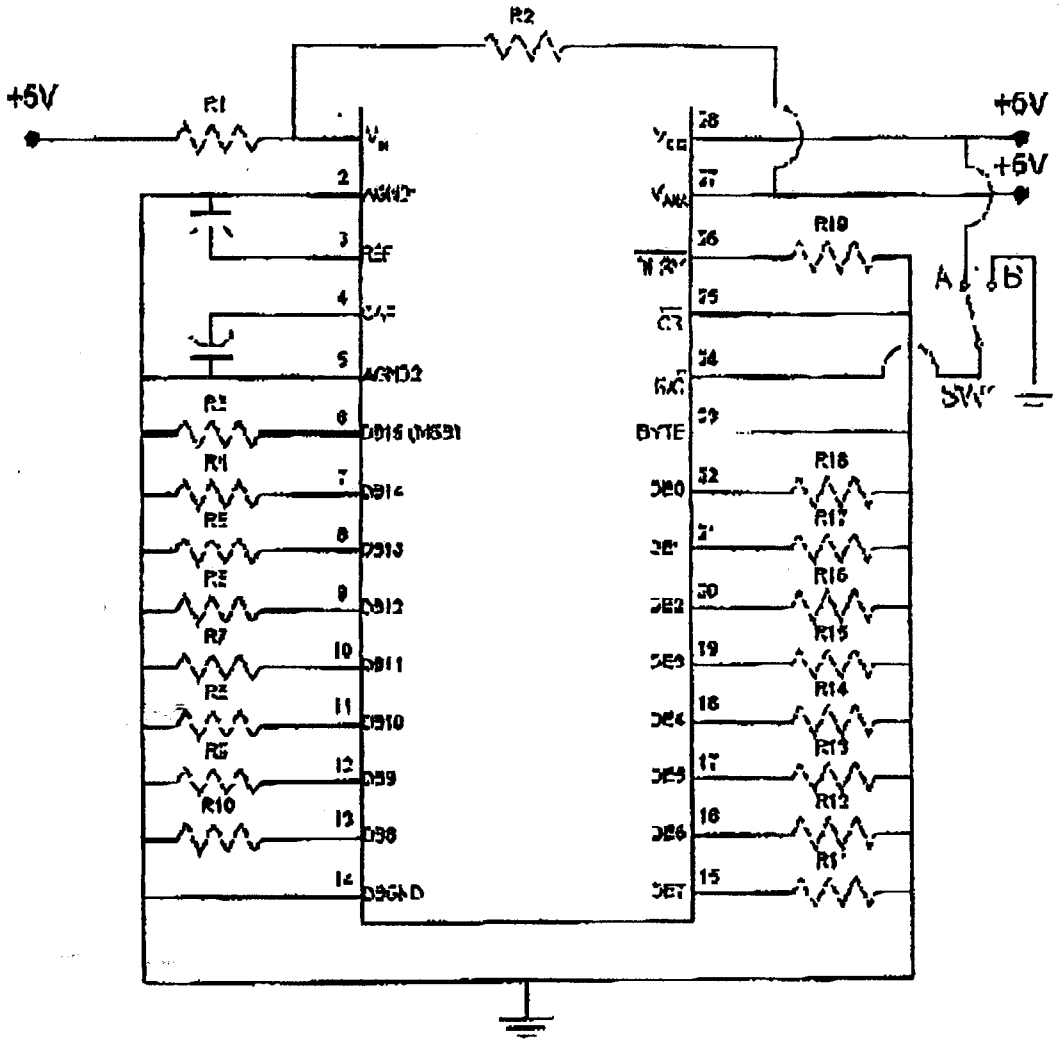
Logiciel

Compte utilisateur : Home : /vlsi/labovlsi
Répertoire de travail : /ad976
Programme de test :
pour le testeur : ad976_new2.ats

pour sequenTEST@ : ad976.tpg.

http://flick.gsfc.nasa.gov/radhome/papers/tid/001_355.pdf

Figure 1. Radiation Bias Circuit for AD976



Notes:

1. R1 = 200Ω ±5% ¼W.
2. R2 = 66.4KΩ ±5% ¼W.
3. R3 – R19 = 10Ω ±5% ¼W.
4. Capacitors are 2.2µf, 25V, Tantalum
5. To start radiation bias, momentarily switch SW1 to position B and then return to position A.