ESA-QCA9966T-C

DSA: HP B. Johlander

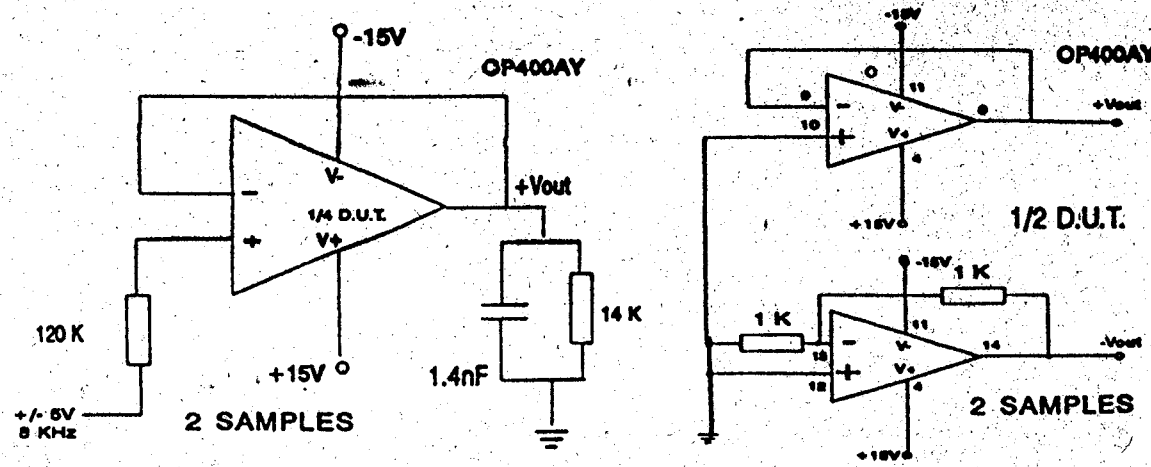
Tesat-Spacecom	TOTAL DOSE RADIATION TEST REPORT No. TL-SIL-RR-077	Issue: 1 Rev.: Date: 3/12/93 Date: Page: 1/14

SCC Component No.: SIL0800903B		Component Designation: OP400AY	Irradiation Spec. No.: TL-SIL-0009
Gen. Spec.: SCC9000 Iss.8 Det. Spec.: TL-SIL-08-009 Is.1 Amend.:		Evaluation: – Acceptance Difussion: – Acceptance Lot: X	Project/Programme: SILEX
Family: 08	Group: 09	Functional Assignment: QUAD OPERATIONAL AMPLIFIER	Package: DIL-14-PINS
Manuf.Name: AD-PMI DIVISION Address: CALIFORNIA (USA)		Irradiation Facility: CIEMAT Address: MADRID (SPAIN)	Test House: CIEMAT Address: MADRID (SPAIN)
Radiation Test Plan No.: TL-SIL-RP-077 Iss.1		Sample Size: 5 Irradiation Devices: 2+2 Control Devices: 1	Date Code: 9232A Mask No.: N/A
Radiation Source: Cobalt-60		Energy: 1,3 MeV Dose Rate: 20 kRad/h	Date of Test: 25.11.93

Electrical Measurements. Parameters Tested:
Input Offset Voltage (V_{os}); Input Offset Current (I_{os}); Positive Input Bias Current (I_{b+}); Negative Input Bias Current (I_{b-}); Power Supply Rejection Ratio (PSRR+ & PSRR-); Large Signal Voltage Gain (RL=10K & RL=2K) (A_{vo}); Output Voltage Swing (RL=10K & RL=2K) (V_o); Slew Rate (AVCL=1) (SR)

Irradiation Conditions: Biased: Y Unbiased: N Test Circuit: Figure 1	Irradiation Measurements Interval: Unbiased: Y Test Circuit: N/A	Annealing Tests: YES Biased: Y Duration: 24/168h Unbiased: N Temp.°C: 25 Test Circuit: Figure 1

Figure 1:



Irradiat. Respons.: O. RAMOS Date: 3/12/93 Signature:	Electr. Test Resp.: F ESPINOSA Date: 3/12/93 Signature:	Approved by QA: M. GASSET Date: 3/12/93 Signature:

SUMMARY

Total dose steady-state irradiation test has been carried out on 5 QUAD OPERATIONAL AMPLIFIER fro AD-PMI, date code 9232A (except the control device which has the same lot date code 9148 as the evaluatio samples) The irradiated parts were labelled as lollows: R1= S/N 58, R2= S/N 59, R3= S/N 60, R4= 61, R5= S/N 1 CONTROL.
R1 to R4 were previously employed as LAT3 destructive samples.

These irradiated devices has been biased with two different circuits; R3 and R4 use the first circuit of Fig. (dinamyc bias, one to one) and R1, R2 use the second circuit of Fig.1 (static bias, two to two).These circuit simulates the application biasing conditions provided by the customer (MMS).

Measurement were manually performed, using oscilloscope.
Slew Rate was measured between 5% and 95% of the input voltage. Note that this parameter was measure according to the user requirements i.e. the input voltage stimuli (±5V) was not according to the applicabl specification (±15V). Therefore, the specification limit for this parameter is provided only as a reference.

The results indicate that:

-Input bias current oversteps specification limit (given as a reference) between 4 and 6 KRad. Recoverin effects are observed after 24h of annealing.

-Power supply rejection ratio oversteps specification around 10 KRad.

-Large signal voltage gain with RL= 10K, overstep specification around 4 KRad while a load resistor of 2 improves, limit up to 6 KRad.

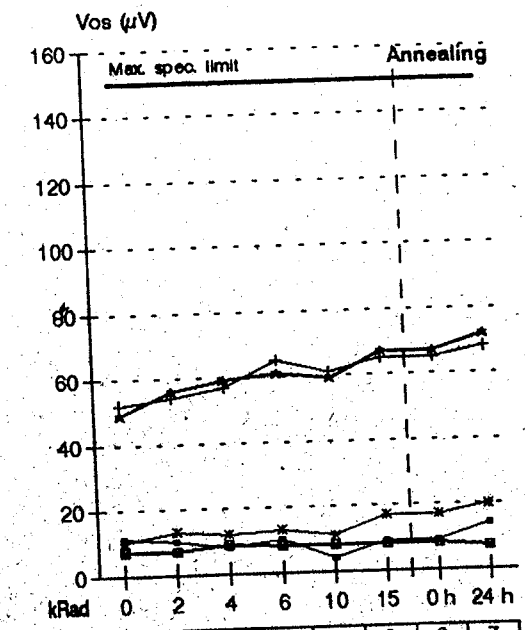
-The rising slew rate with A_V= 1 decreased linearly with radiation exposure. Specification limit is provide for informative proposes. Falling slew rate shows a better behaviour and oversteps out of speccificatio between 10 and 15 KRad.

-Annealing data and time in/out events will be provided in a new revision.

PRELIMINARY CONCLUSIONS

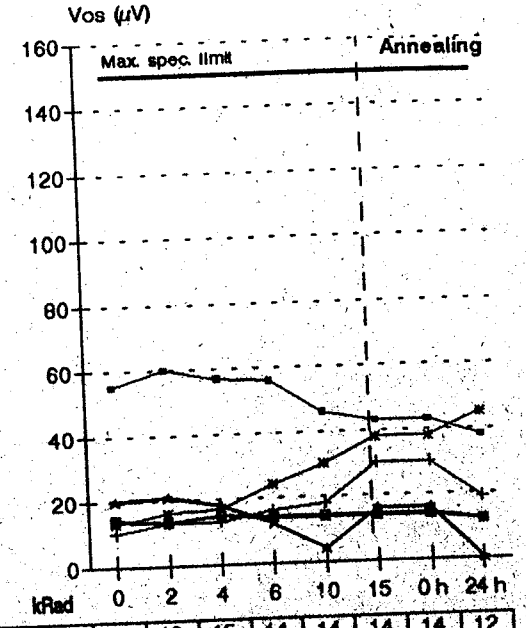
OP400AY is not suitable for using in SILEX project with FPSCE biasing conditions according to th specification limits. The most critical parameter for user equimentent is slew rate which is very damage under irradiation exposure.

P400AY
Input Offset Voltage (#1)



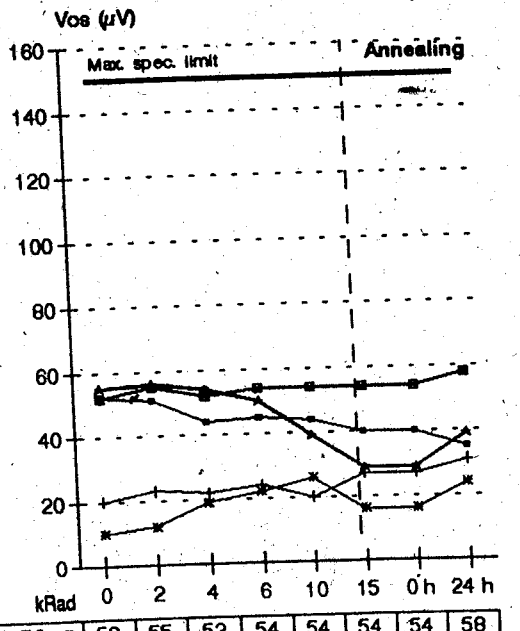
CONTROL R6	7	7	9	8	8	8	8	7
R1	49	56	59	61	59	67	67	72
R2	10	13	12	13	11	17	17	20
R3	11	10	8	10	4	9	9	14
R4	52	54	57	65	61	65	65	68

P400AY
Input Offset Voltage (#2)



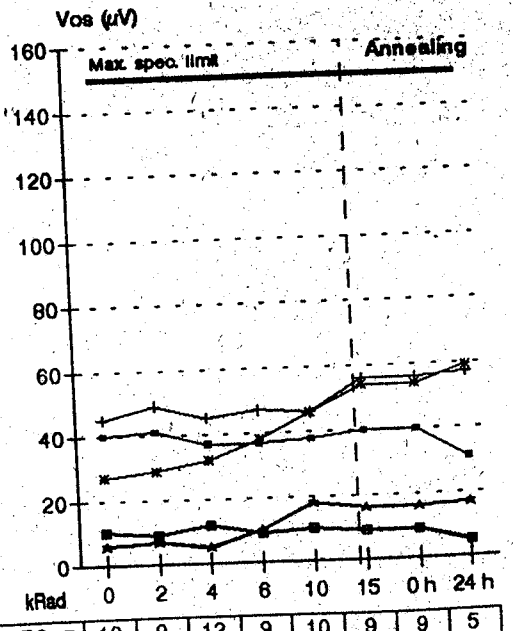
CONTROL R6	14	13	15	14	14	14	14	12
R1	20	21	18	12	4	16	16	0
R2	13	16	17	24	30	38	38	45
R3	55	60	57	56	46	43	43	38
R4	10	13	13	16	18	30	30	19

P400AY
Input Offset Voltage (#3)



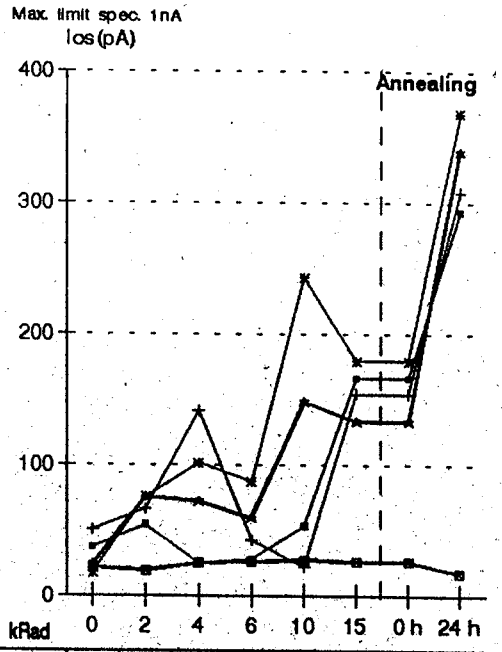
CONTROL R6	52	55	52	54	54	54	54	58
R1	55	56	54	50	39	29	29	39
R2	10	12	19	22	26	16	16	24
R3	52	51	44	45	44	40	40	35
R4	20	23	22	24	20	27	27	31

OP400AY
Input Offset Voltage (#4)



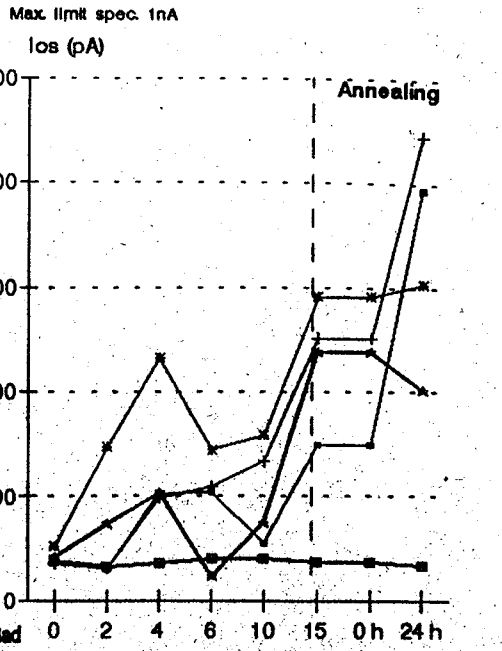
CONTROL R6	10	9	12	9	10	9	9	5
R1	6	7	5	10	18	16	16	17
R2	27	29	32	38	46	54	54	59
R3	40	41	37	37	38	40.	40	31
R4	45	49	45	47	46	56	56	57

OP400AY
Input Offset Current (#1)



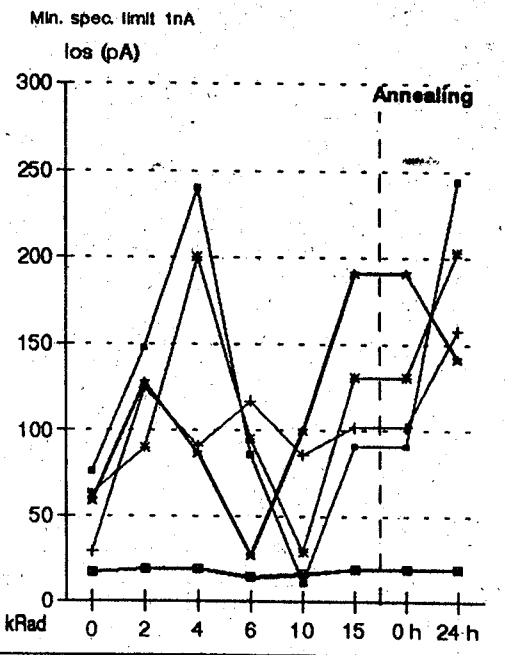
CONTROL R6	21	19	25	26	27	26	26	17
R1	24	75	72	59	148	133	133	339
R2	17	75	101	87	243	179	179	368
R3	37	54	24	28	53	166	166	293
R4	50	66	141	42	22	154	154	308

OP400AY
Input Offset Current (#2)



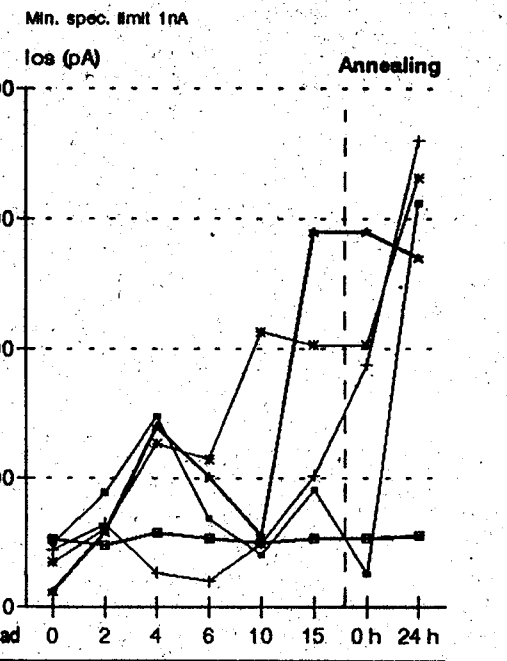
CONTROL R6	38	32	36	40	40	37	37	33
R1	41	73	103	23	74	238	238	201
R2	52	147	232	144	158	291	291	303
R3	37	30	102	104	55	149	149	394
R4	35	31	98	109	133	251	251	446

OP400AY
Input Offset Current (#3)



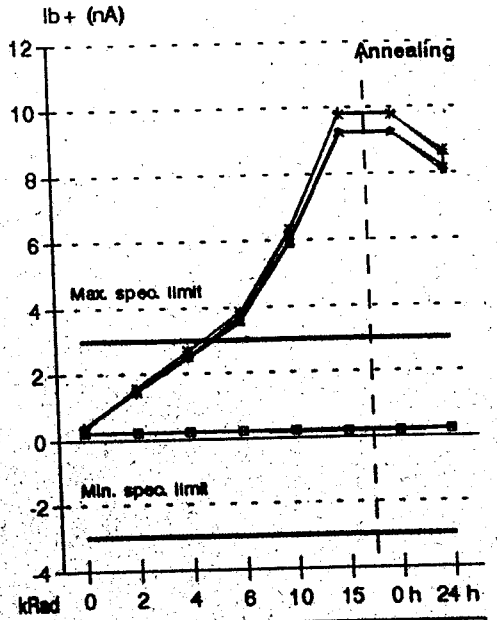
CONTROL R6	17	19	19	14	16	19	19	19
R1	59	128	87	27	100	191	191	142
R2	63	90	200	95	29	131	131	203
R3	76	148	240	86	11	91	91	244
R4	29	125	91	117	86	102	102	158

OP400AY
Input Offset Current (#4)



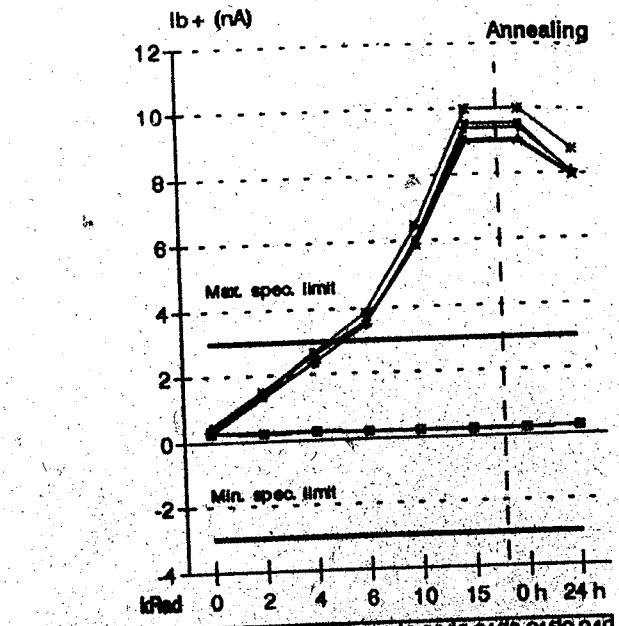
CONTROL R6	53	48	58	54	50	54	54	55
R1	12	58	140	101	56	290	290	270
R2	35	61	127	115	213	203	203	332
R3	50	89	148	69	41	91	26	312
R4	44	65	27	20	50	102	188	360

OP400AY
Input Bias Current + (#1)



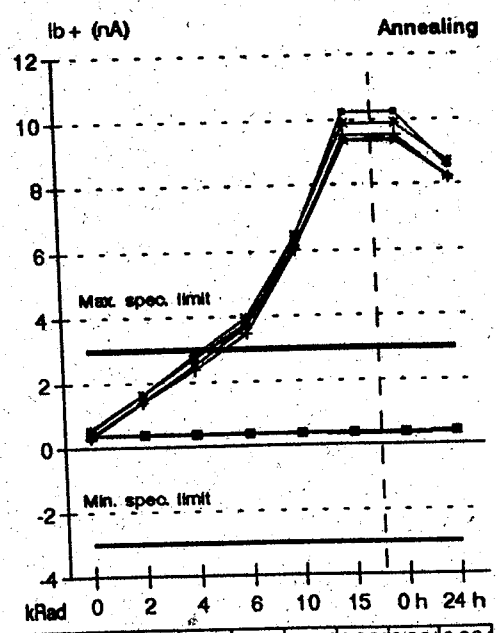
CONTROL R6	0,22	0,212	0,223	0,206	0,196	0,196	0,196	0,225
R1	0,401	1,472	2,533	3,567	5,963	9,244	9,244	8,197
R2	0,272	1,56	2,663	3,653	6,323	9,779	9,779	8,667
R3	0,356	1,434	2,469	3,519	5,89	9,246	9,246	8,03
R4	0,37	1,451	2,504	3,73	6,24	9,822	9,822	8,506

OP400AY
Input Bias Current + (#2)



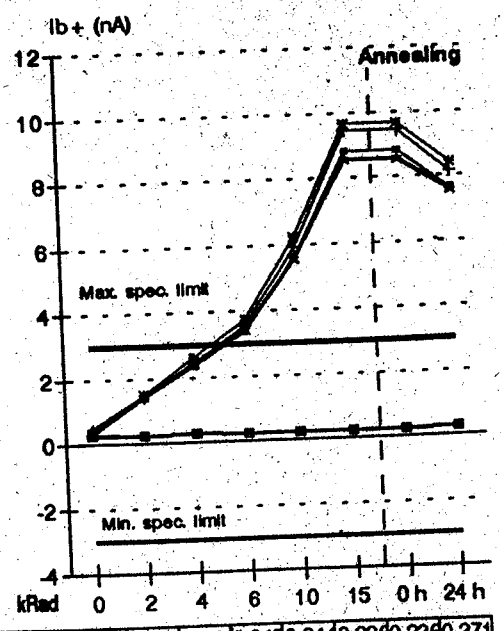
CONTROL R6	0,241	0,23	0,244	0,226	0,221	0,215	0,215	0,248
R1	0,412	1,48	2,61	3,551	5,864	9,014	9,014	7,844
R2	0,3	1,501	2,665	3,832	6,475	10,001	10,009	8,749
R3	0,249	1,324	2,342	3,454	6,023	9,547	9,547	7,999
R4	0,312	1,407	2,357	3,493	5,895	9,41	9,41	8,053

OP400AY
Input Bias Current + (#3)



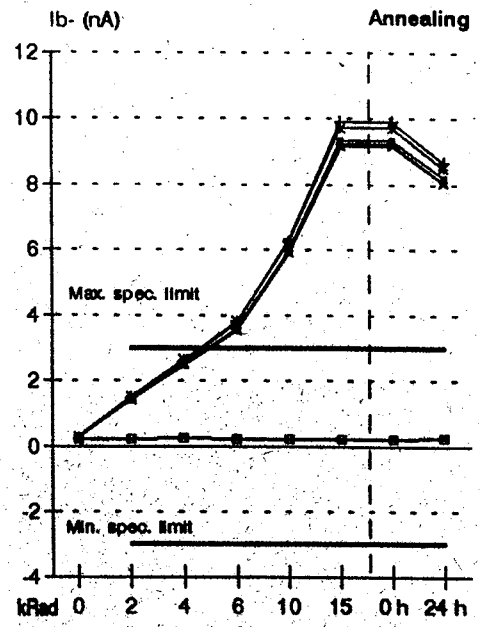
CONTROL R6	0,369	0,373	0,385	0,37	0,368	0,361	0,361	0,394
R1	0,536	1,602	2,744	3,733	6,136	9,37	9,37	8,231
R2	0,507	1,624	2,851	3,965	6,464	9,887	9,887	8,7
R3	0,346	1,403	2,506	3,686	6,424	10,241	10,248	8,574
R4	0,296	1,372	2,361	3,491	6,008	9,544	9,544	8,206

OP400AY
Input Bias Current + (#4)



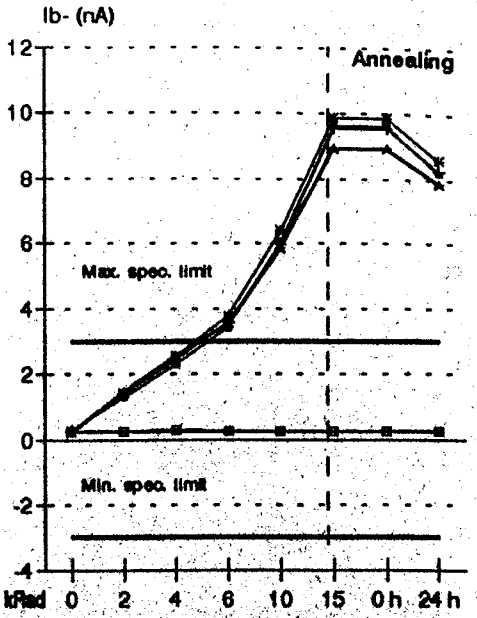
CONTROL R6	0,253	0,249	0,26	0,245	0,244	0,236	0,236	0,271
R1	0,437	1,444	2,425	3,437	5,553	8,56	8,56	7,553
R2	0,273	1,492	2,61	3,732	6,22	9,663	9,663	8,422
R3	0,391	1,365	2,349	3,355	5,626	8,819	8,819	7,63
R4	0,286	1,396	2,432	3,562	5,92	9,446	9,446	8,136

OP400AY
Input Bias Current - (#1)



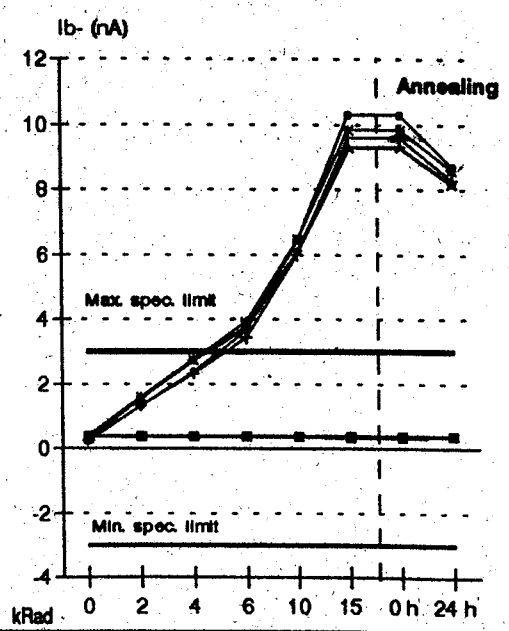
CONTROL R6	0,226	0,226	0,241	0,225	0,221	0,216	0,216	0,237
R1	0,301	1,435	2,503	3,545	9,169	9,169	9,169	9,036
R2	0,291	1,523	2,644	3,817	6,214	9,704	9,704	9,494
R3	0,256	1,412	2,461	3,542	5,916	9,337	9,337	9,184
R4	0,247	1,483	2,58	3,764	6,254	9,912	9,912	9,669

OP400AY
Input Bias Current - (#2)



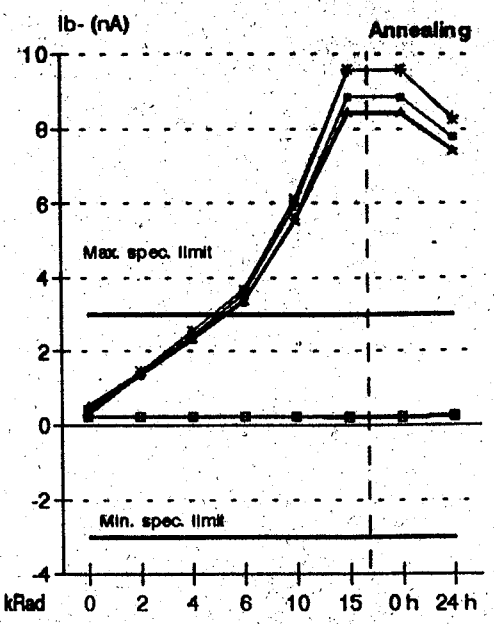
CONTROL R6	0,256	0,25	0,266	0,253	0,246	0,24	0,24	0,265
R1	0,2	1,45	2,566	3,545	5,83	8,91	8,91	7,851
R2	0,215	1,43	2,541	3,761	6,405	9,87	9,87	9,605
R3	0,301	1,312	2,297	3,405	6,056	9,627	9,627	9,202
R4	0,278	1,391	2,414	3,552	5,969	9,549	9,549	9,262

OP400AY
Input Bias Current - (#3)



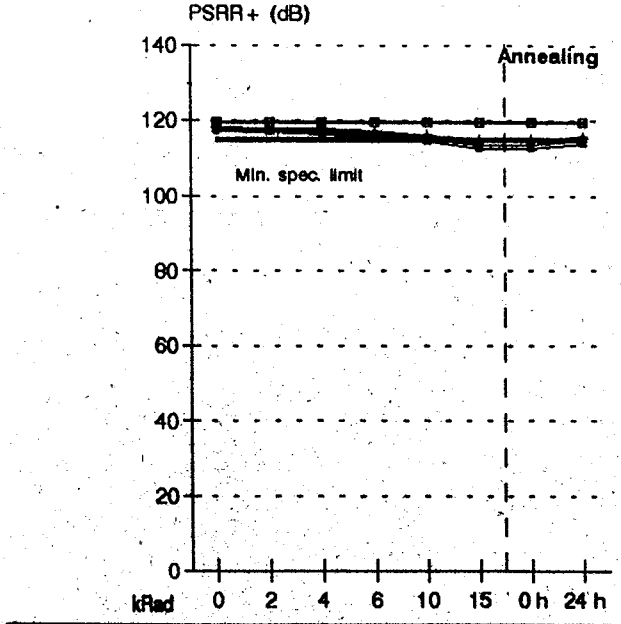
CONTROL R6	0,37	0,368	0,382	0,367	0,365	0,357	0,357	0,368
R1	0,32	1,544	2,711	3,754	6,087	9,286	9,286	8,167
R2	0,381	1,58	2,753	3,921	6,456	9,834	9,834	8,608
R3	0,211	1,332	2,397	3,646	6,424	10,29	10,29	8,702
R4	0,256	1,312	2,317	3,433	5,979	9,609	9,609	8,285

OP400AY
Input Bias Current - (#4)



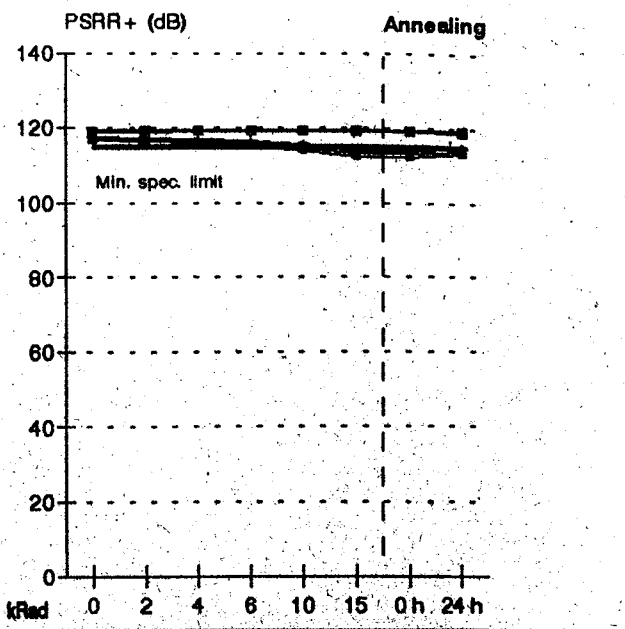
CONTROL R6	0,227	0,229	0,235	0,224	0,226	0,215	0,215	0,247
R1	0,5	1,417	2,363	3,391	5,535	8,426	8,426	7,425
R2	0,346	1,466	2,55	3,682	6,126	9,574	9,574	8,267
R3	0,417	1,344	2,281	3,333	5,618	8,847	8,847	7,789
R4	0,283	1,369	2,425	3,559	5,953	9,557	9,557	8,32

OP400AY
Power Supply Rejection Ratio + (#1)



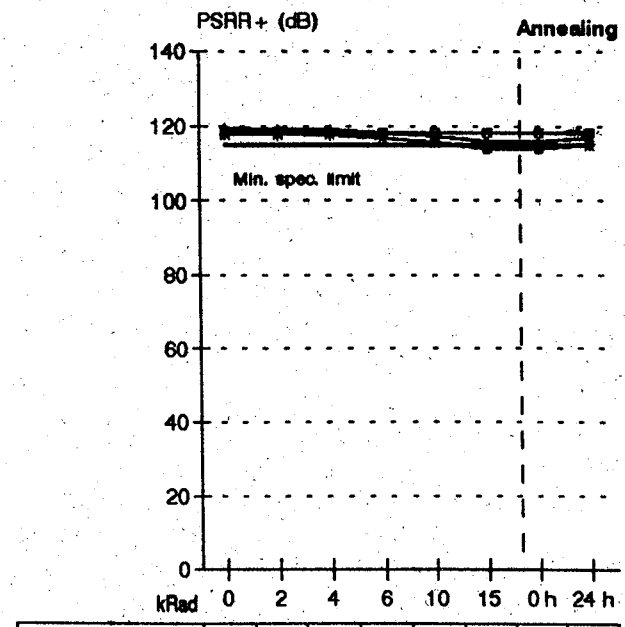
CONTROL R6	119,5	119,6	119,5	119,6	119,6	119,5	119,5	119,6
R1	118	117,6	117,5	116,9	115,6	114,7	114,7	115,5
R2	117,8	117,3	116,8	116,2	115,1	113,4	113,4	114,6
R3	117,2	117,0	116,4	115,7	114,5	112,7	112,7	113,6
R4	118,3	117,9	117,6	117,1	116,1	114,9	114,9	115,5

OP400AY
Power Supply Rejection Ratio + (#2)



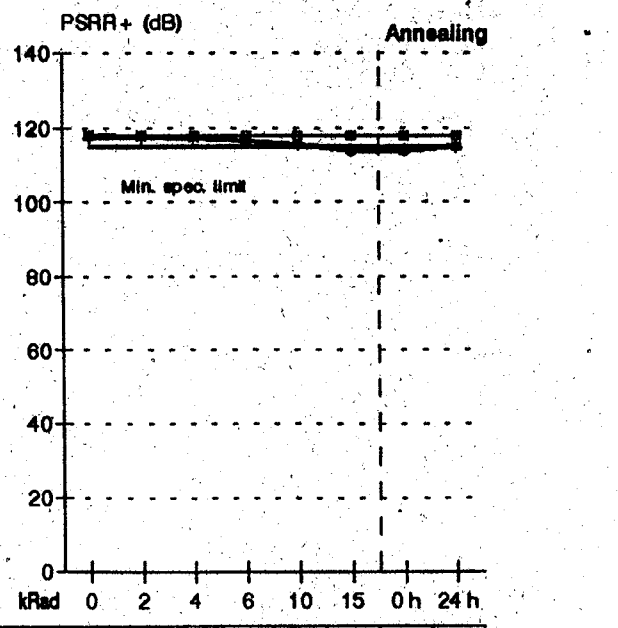
CONTROL R6	119,1	119,1	119,2	119,2	119,1	119,1	119,1	119,1
R1	117,5	117,1	116,7	116,1	115,5	114,2	114,2	114,9
R2	117,1	116,6	116,2	115,6	114,5	113,1	113,1	113,9
R3	116,8	116,3	115,9	115,1	113,8	112,3	112,3	113,2
R4	117,6	117,3	117,0	116,5	115,3	113,9	113,9	114,7

OP400AY
Power Supply Rejection Ratio + (#3)



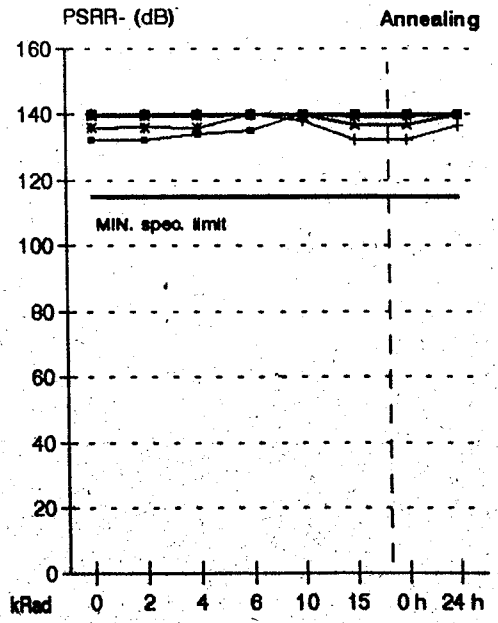
CONTROL R6	118,2	118,3	118,2	118,1	118,2	118,2	118,2	118,2
R1	119,3	119,2	119,0	118,3	117,3	115,9	115,9	117,0
R2	117,7	117,6	117,5	116,5	115,5	114,1	114,1	114,9
R3	119,3	118,8	118	117,1	115,3	113,5	113,5	114,6
R4	117,8	117,7	117,4	116,6	115,6	114,3	114,3	115,3

OP400AY
Power Supply Rejection Ratio + (#4)



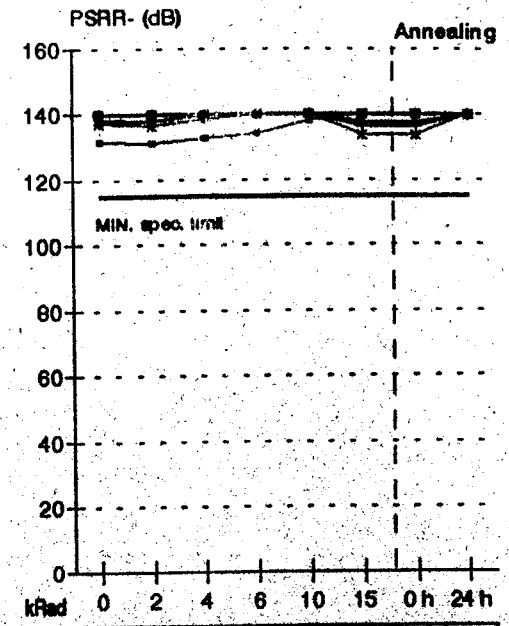
CONTROL R6	118	117,9	118,0	118	117,8	117,8	117,8	118,0
R1	117,9	117,6	117,3	116,8	115,7	114,5	114,5	115,3
R2	118,2	118,0	117,7	116,8	115,8	114,0	114,0	115,1
R3	118,3	118,1	117,8	116,7	115,2	113,4	113,4	114,6
R4	117,2	117,0	116,7	116,1	115,2	113,9	113,9	114,6

OP400AY
Power Supply Rejection Ratio - (#1)



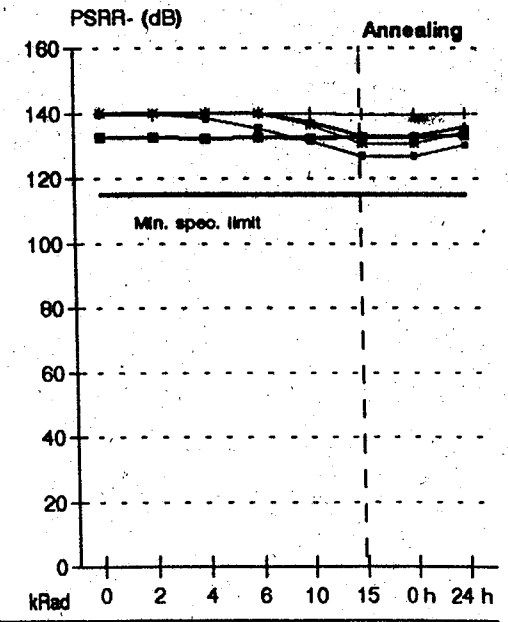
CONTROL R6	140	140	140	140	140	140	140	140
R1	139,5	139,4	139,5	140	140	136,5	136,5	140
R2	135,9	136,1	135,9	140	140	139,1	139,1	140
R3	132,3	132,3	134,1	135,0	140	140	140	140
R4	140	140	140	140	136,0	132,2	132,2	136,5

OP400AY
Power Supply Rejection Ratio - (#2)



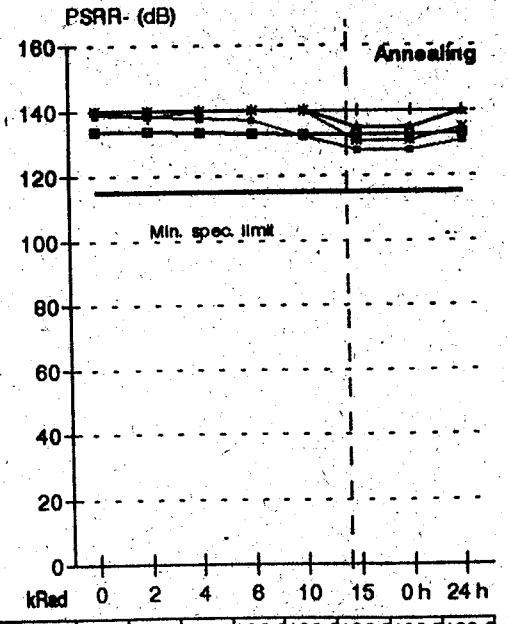
CONTROL R6	140	140	140	140	140	140	140	140
R1	138,1	137,8	140	140	140	137,3	137,3	140
R2	137,1	136,3	138,4	140	140	133,6	133,6	140
R3	131,9	131,2	132,6	134,1	136,0	140	140	140
R4	140	140	140	140	140	136,1	136,1	140

OP400AY
Power Supply Rejection Ratio - (#3)



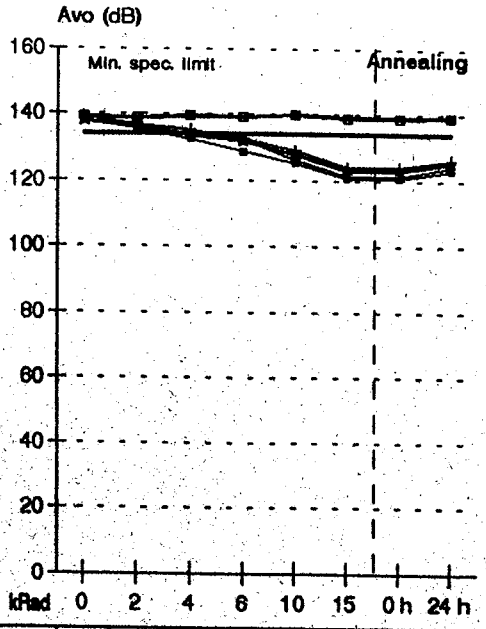
CONTROL R6	132,6	132,5	132,2	132,6	132,4	132,5	132,5	133,2
R1	140	140	140	140	137,2	133,0	133,0	135,6
R2	140	140	140	140	136,4	130,6	130,6	134,1
R3	139,5	139,6	138,3	135,4	131,3	126,9	126,9	130,3
R4	140	139,4	140	140	140	139,6	139,6	140

OP400AY
Power Supply Rejection Ratio - (#4)



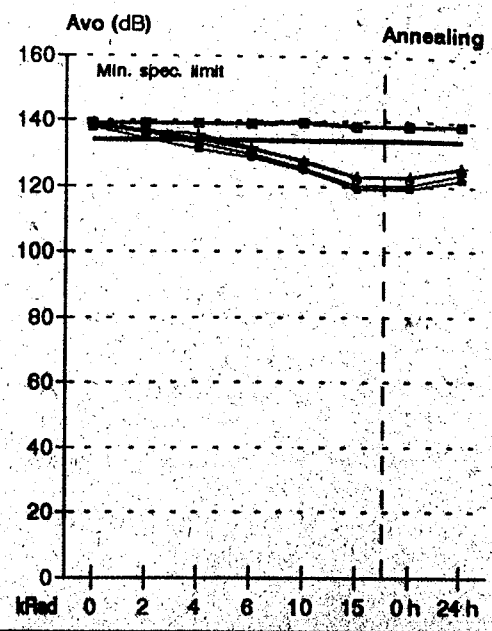
CONTROL R6	133,7	133,6	133,3	132,6	132,6	132,5	132,5	133,0
R1	140	140	140	140	140	134,7	134,7	139,8
R2	140	140	140	140	140	130,7	130,7	134,6
R3	138,7	138,1	137,5	137,0	131,9	127,6	127,6	130,8
R4	139,9	137,9	140	140	140	140	140	140

OP400AY
Large Signal Voltage Gain (RL=10K) (#1)



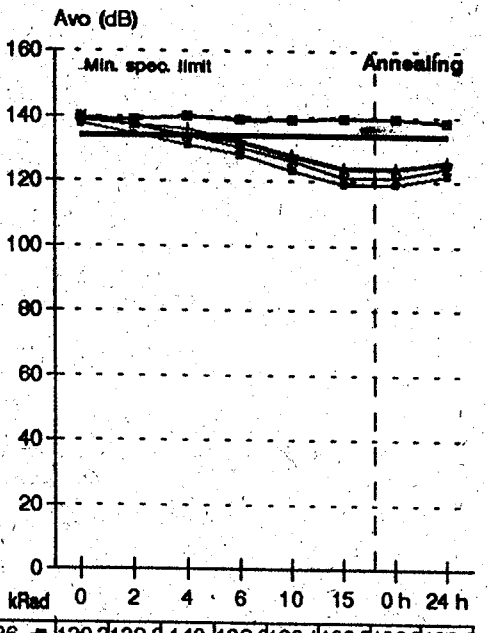
CONTROL R6	139	138,6	139,3	139,0	140	139,8	139,8	139,8	139,1
R1	137,6	136,6	133,3	131,6	127,7	123,0	123,0	125,5	
R2	138,2	135,4	134,0	132,2	126,4	121,3	121,3	124,1	
R3	137,8	135,3	132,3	128,5	125,2	120,4	120,4	123,2	
R4	139,1	136,7	135,2	132,5	129,0	124,0	124,0	126,3	

OP400AY
Large Signal Voltage Gain (RL=10K) (#2)



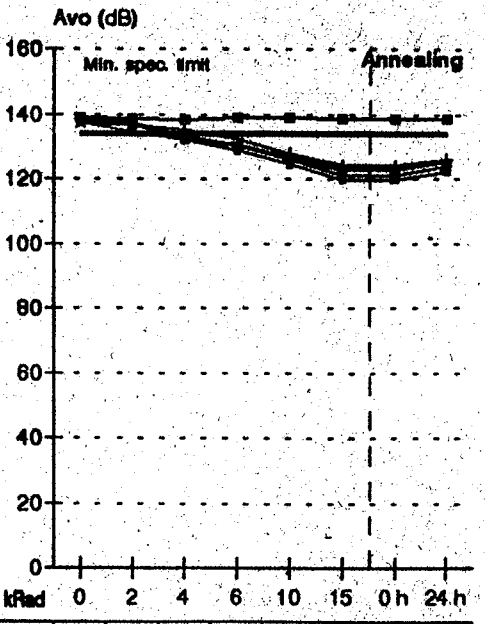
CONTROL R6	139,2	139,1	139,2	139,1	139,6	139,6	139,5	139,6	
R1	138,7	136,6	134,1	131,2	127,6	122,6	122,6	125,5	
R2	138,2	136,0	133,0	129,7	125,6	120,2	120,2	123,6	
R3	137,6	134,4	131,3	128,7	124,9	119,1	119,1	122,1	
R4	139,1	136,7	135,6	131,8	127,4	122,6	122,6	125,7	

OP400AY
Large Signal Voltage Gain (RL=10K) - (#3)



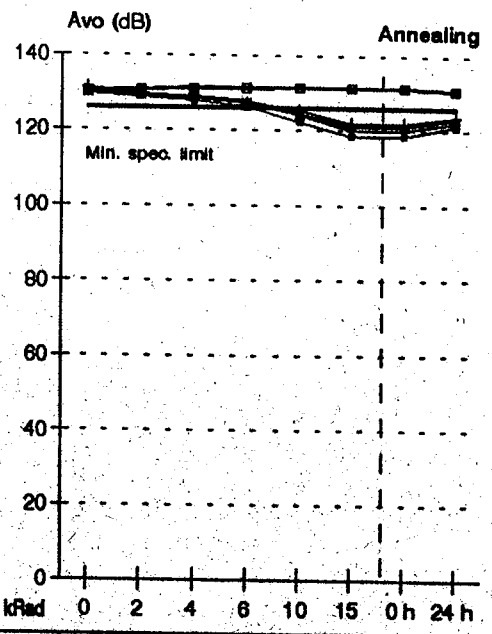
CONTROL R6	139,3	138,9	140	138,6	139,1	139,5	139,5	138,2	
R1	139,5	137,0	134,1	131,6	127,6	123,6	123,6	126,0	
R2	140	137,4	133,7	130,2	126,4	121,0	121,0	124,2	
R3	137,6	134,6	131,2	128,0	123,3	119,0	119,0	121,6	
R4	139	137,5	136,0	132,4	128,1	124,2	124,2	126,2	

OP400AY
Large Signal Voltage Gain (RL=10K) (#4)



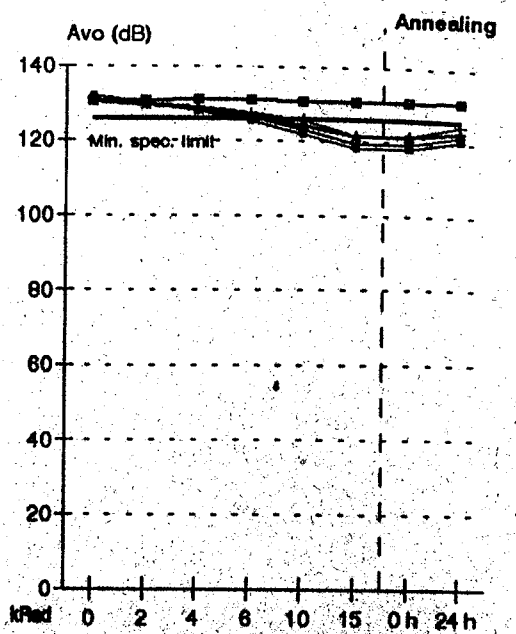
CONTROL R6	139,1	138,7	138,2	139,1	139,1	138,6	138,6	138,7	
R1	137,4	137,0	132,7	130,5	126,4	122,8	122,8	125,6	
R2	138,7	137,2	133,5	130,2	126,1	121,2	121,2	124,1	
R3	137,5	134,4	131,8	128,7	124,4	119,6	119,6	122,2	
R4	139,3	136,6	135,2	132,4	127,9	124,2	124,2	126,2	

OP400AY
Large Signal Voltage Gain (RL=2K) (#1)



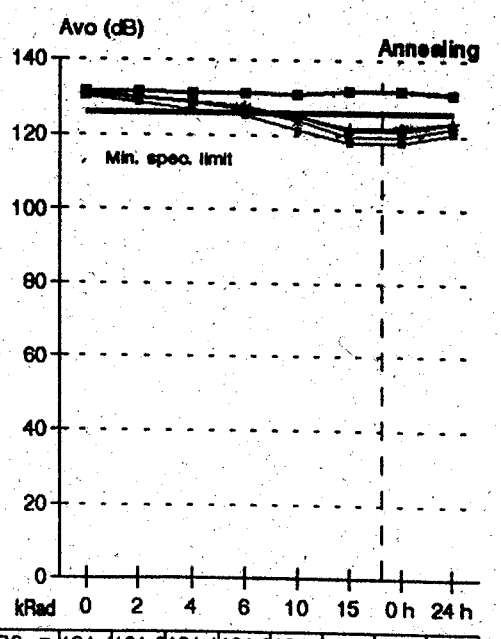
CONTROL R6	130,5	130,7	131,1	131,2	131,3	131,2	131,2	130,6
R1	130,3	129,3	128,6	127,5	124,3	121,0	121,0	123,3
R2	129,6	129,1	128,5	127,2	123,9	119,9	119,9	122,2
R3	129,6	128,6	127,6	126,1	122,3	118,6	118,6	121,1
R4	131,3	129,7	128,7	127,4	125,4	121,9	121,9	123,6

OP400AY
Large Signal Voltage Gain (RL=2K) (#2)



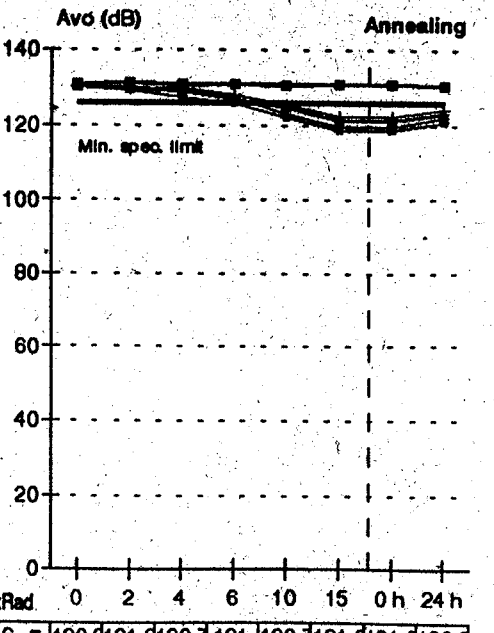
CONTROL R6	130,7	130,6	131	130,6	130,6	130,6	130,6	131,1
R1	130,4	129,6	128,6	126,7	124,3	121,5	121,5	122,6
R2	130,5	129,6	128,0	126,1	123,1	119,3	119,3	121,6
R3	132	130,0	127,6	125,4	121,6	118,3	118,3	120,6
R4	131,2	129,8	129,0	127,4	125,6	121,4	121,4	124,5

OP400AY
Large Signal Voltage Gain (RL=2K) (#3)



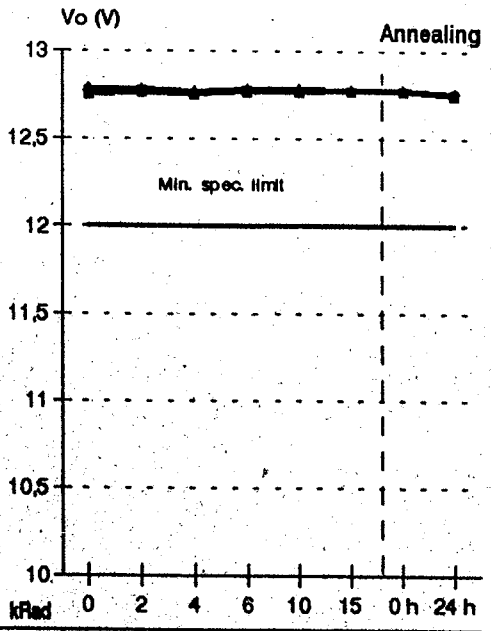
CONTROL R6	131,4	131,6	131,1	131,3	130,8	131,8	131,8	131,0
R1	130,7	129,6	128,6	127,0	125,0	121,4	121,4	123,4
R2	131,2	130,0	128,7	127,0	123,9	119,6	119,6	122,2
R3	130,3	128,5	126,6	125,1	121,3	118,0	118,0	120,5
R4	130,9	129,6	129,0	127,6	124,7	122,0	122,0	123,5

OP400AY
Large Signal Voltage Gain (RL=2K) (#4)



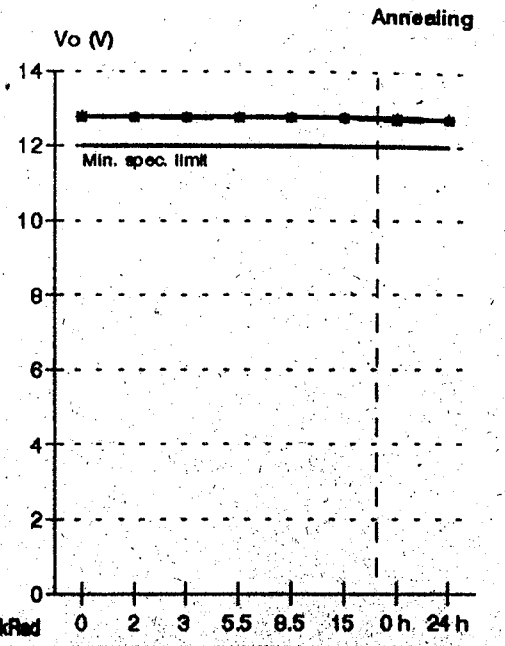
CONTROL R6	130,6	131,2	130,7	131	130,7	131,0	131,0	130,6
R1	130,2	129,7	128,8	126,8	124,6	121,2	121,2	123,1
R2	130,6	130,2	128,8	127,2	123,1	119,6	119,6	122,1
R3	130	129,1	127,3	125,6	122,1	118,6	118,6	120,7
R4	130,6	129,6	129,7	128	125,3	122,2	122,2	124,3

OP400AY
Output Voltage Swing (RL=10K) (#1)



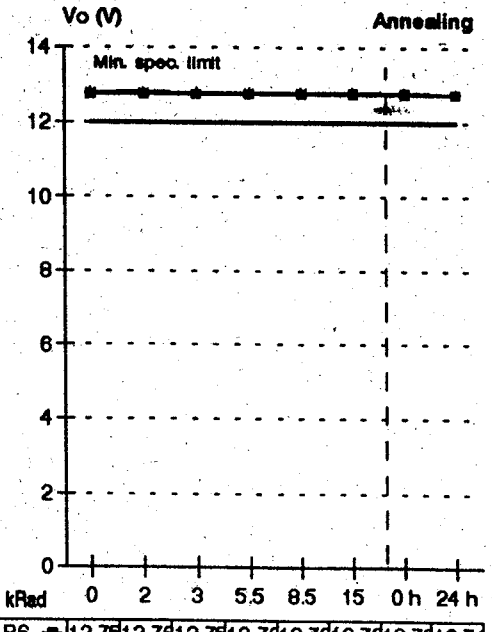
CONTROL R6	12,75	12,75	12,75	12,76	12,76	12,76	12,76	12,74
R1	12,76	12,76	12,77	12,76	12,76	12,77	12,77	12,76
R2	12,75	12,77	12,75	12,77	12,76	12,76	12,76	12,74
R3	12,76	12,76	12,76	12,76	12,76	12,77	12,77	12,76
R4	12,77	12,77	12,76	12,77	12,77	12,77	12,77	12,75

OP400AY
Output Voltage Swing - (#2)



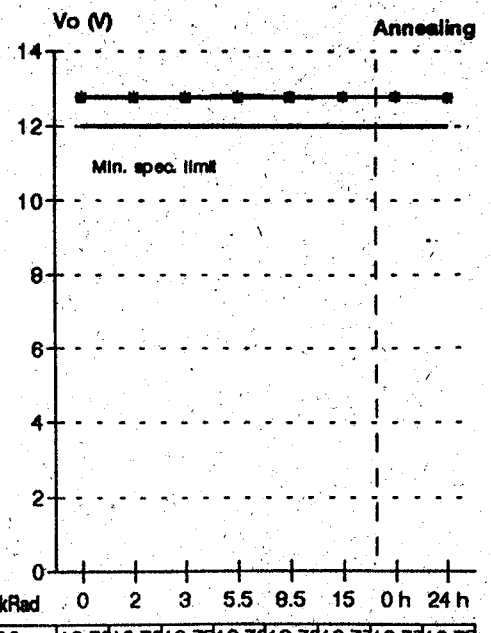
CONTROL R6	12,76	12,76	12,75	12,76	12,76	12,77	12,77	12,74
R1	12,76	12,76	12,77	12,76	12,76	12,76	12,76	12,76
R2	12,76	12,76	12,76	12,77	12,76	12,76	12,76	12,74
R3	12,76	12,76	12,77	12,76	12,76	12,77	12,77	12,76
R4	12,76	12,76	12,77	12,76	12,76	12,77	12,77	12,76

OP400AY
Output Voltage Swing - (#3)



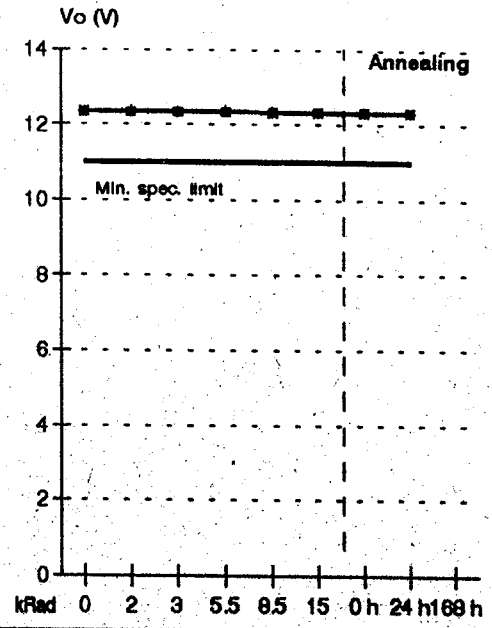
CONTROL R6	12,75	12,76	12,75	12,76	12,76	12,76	12,76	12,74
R1	12,76	12,76	12,77	12,76	12,76	12,76	12,76	12,76
R2	12,77	12,76	12,76	12,76	12,76	12,76	12,76	12,75
R3	12,76	12,76	12,77	12,76	12,76	12,77	12,77	12,76
R4	12,77	12,76	12,77	12,76	12,76	12,77	12,77	12,76

OP400AY
Output Voltage Swing - (#4)



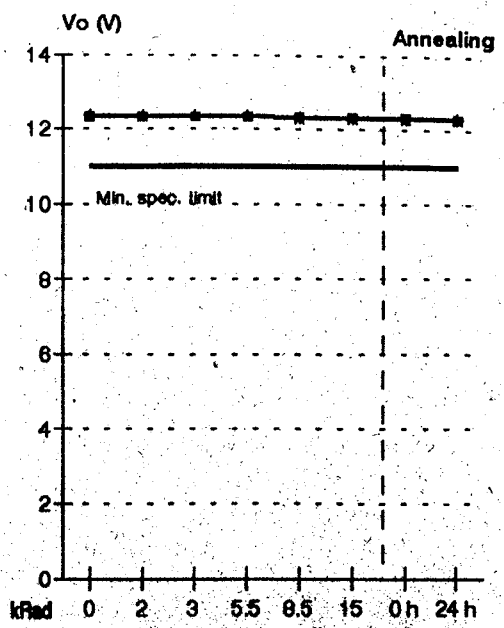
CONTROL R6	12,76	12,76	12,75	12,76	12,76	12,77	12,77	12,75
R1	12,76	12,76	12,77	12,76	12,76	12,76	12,76	12,76
R2	12,76	12,76	12,76	12,76	12,77	12,77	12,77	12,75
R3	12,76	12,76	12,77	12,76	12,76	12,76	12,76	12,76
R4	12,77	12,76	12,77	12,76	12,76	12,77	12,77	12,76

OP400AY
Output Voltage Swing (RL=2K) (#1)



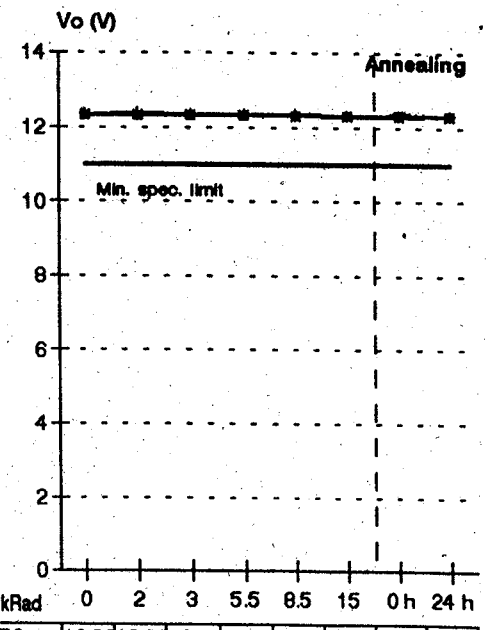
CONTROL R6	12,33	12,33	12,32	12,33	12,33	12,33	12,33	12,32	
R1	12,35	12,36	12,34	12,35	12,33	12,30	12,30	12,31	
R2	12,35	12,35	12,33	12,33	12,3	12,29	12,29	12,29	
R3	12,33	12,34	12,32	12,33	12,31	12,29	12,29	12,29	
R4	12,35	12,36	12,33	12,35	12,34	12,32	12,32	12,32	

OP400AY
Output Voltage Swing (RL=2K) (#2)



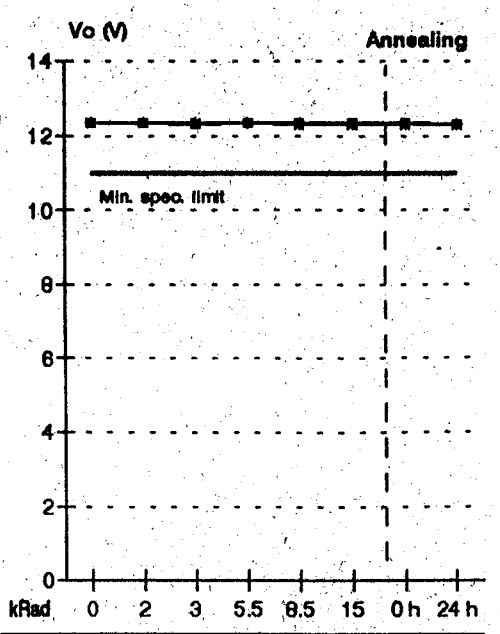
CONTROL R6	12,33	12,32	12,31	12,32	12,32	12,32	12,32	12,31	
R1	12,35	12,36	12,34	12,35	12,33	12,30	12,30	12,30	
R2	12,34	12,33	12,32	12,32	12,27	12,27	12,27	12,27	
R3	12,34	12,34	12,32	12,33	12,29	12,27	12,27	12,26	
R4	12,36	12,36	12,35	12,35	12,34	12,31	12,31	12,32	

OP400AY
Output Voltage Swing (RL=2K) (#3)



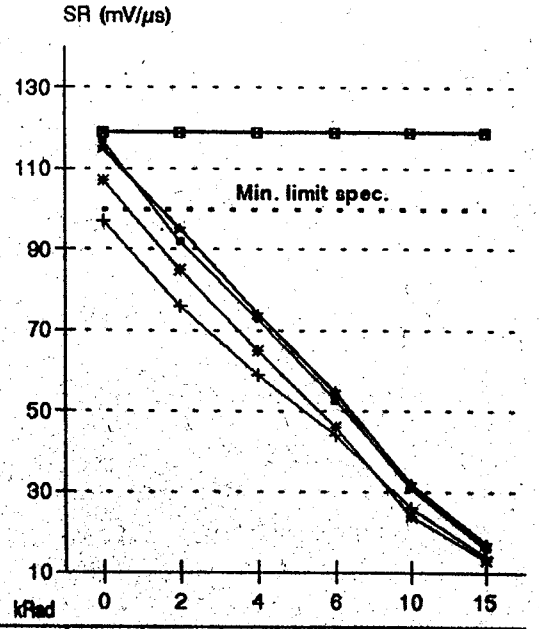
CONTROL R6	12,32	12,32	12,31	12,32	12,32	12,32	12,32	12,31	
R1	12,35	12,36	12,34	12,35	12,33	12,30	12,30	12,30	
R2	12,35	12,35	12,33	12,33	12,29	12,29	12,29	12,28	
R3	12,34	12,34	12,32	12,33	12,30	12,28	12,28	12,29	
R4	12,35	12,36	12,35	12,36	12,35	12,32	12,32	12,32	

OP400AY
Output Voltage Swing (RL=2K) (#4)



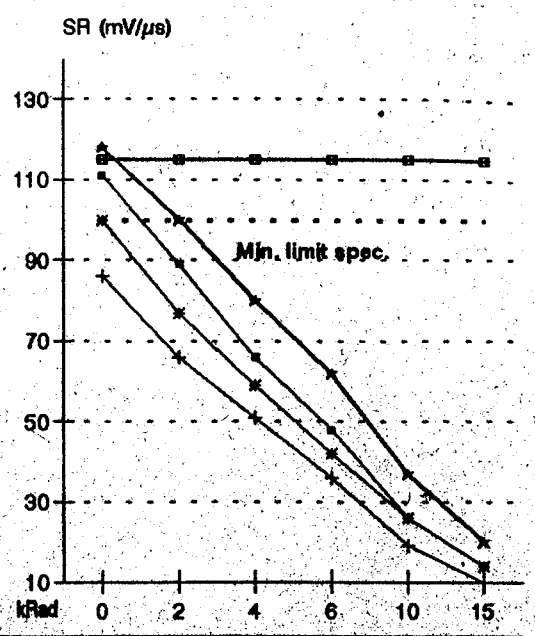
CONTROL R6	12,34	12,33	12,33	12,33	12,33	12,34	12,34	12,32	
R1	12,35	12,35	12,34	12,35	12,32	12,30	12,30	12,30	
R2	12,36	12,35	12,33	12,34	12,30	12,28	12,28	12,28	
R3	12,35	12,35	12,33	12,34	12,32	12,28	12,28	12,30	
R4	12,36	12,36	12,35	12,35	12,34	12,32	12,32	12,32	

OP400AY
Slew Rate+ (AVCL=+1(#1)



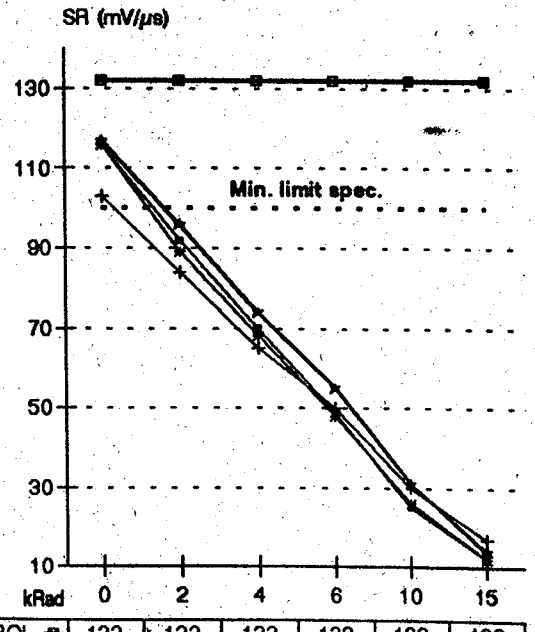
CONTROL	⊕	119	119	119	119	119	119
R1	✱	115	95	74	55	32	17
R2	✱	107	85	65	46	24	13
R3	⊕	117	92	73	53	31	16
R4	+	97	76	59	44	26	14

OP400AY
Slew Rate+ (AVCL=+1) (#2)



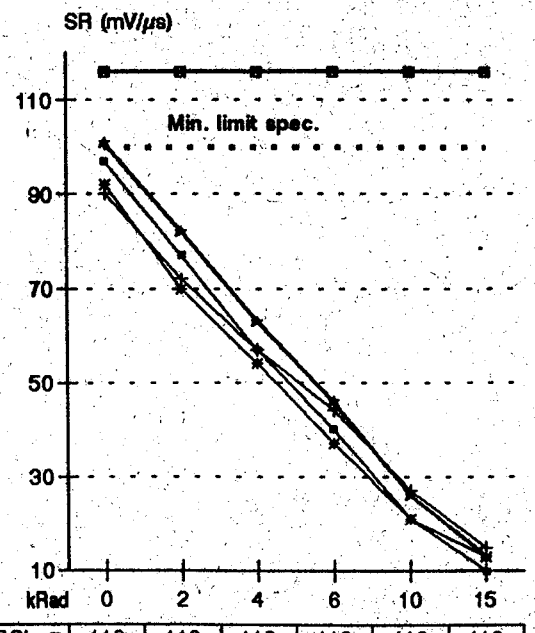
CONTROL	⊕	115	115	115	115	115	115
R1	✱	118	100	80	62	37	20
R2	✱	100	77	59	42	26	14
R3	⊕	111	89	66	48	26	14
R4	+	86	66	51	36	19	10

OP400AY
Slew Rate+ (AVCL=+1) (#3)



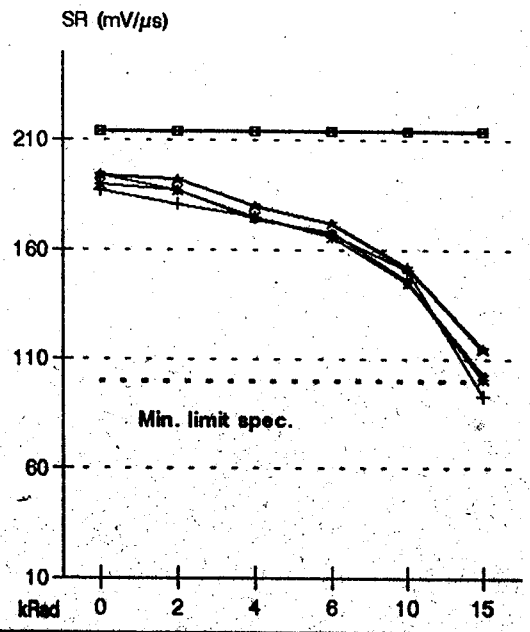
CONTROL	⊕	132	132	132	132	132	132
R1	✱	117	96	74	55	31	14
R2	✱	116	89	68	48	26	12
R3	⊕	116	92	70	49	25	12
R4	+	103	84	65	50	30	17

OP400AY
Slew Rate+ (AVCL=+1) (#4)



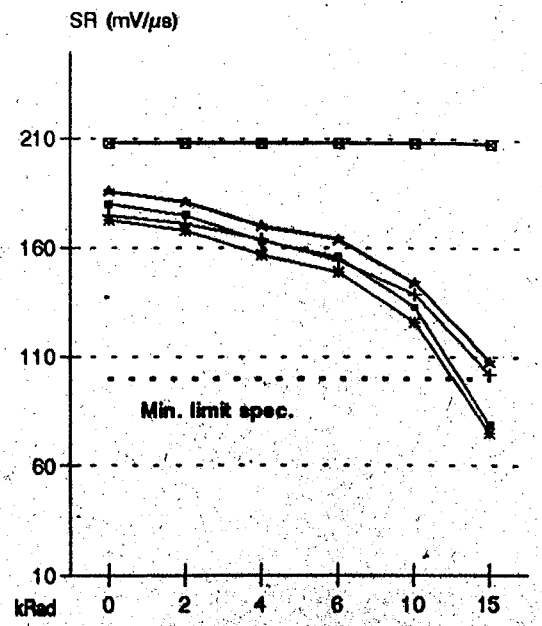
CONTROL	⊕	116	116	116	116	116	116
R1	✱	101	82	63	46	26	13
R2	✱	92	70	54	37	21	13
R3	⊕	97	77	57	40	21	10
R4	+	90	72	57	44	27	15

OP400AY
Slew Rate- (AVCL=+1) (#1)



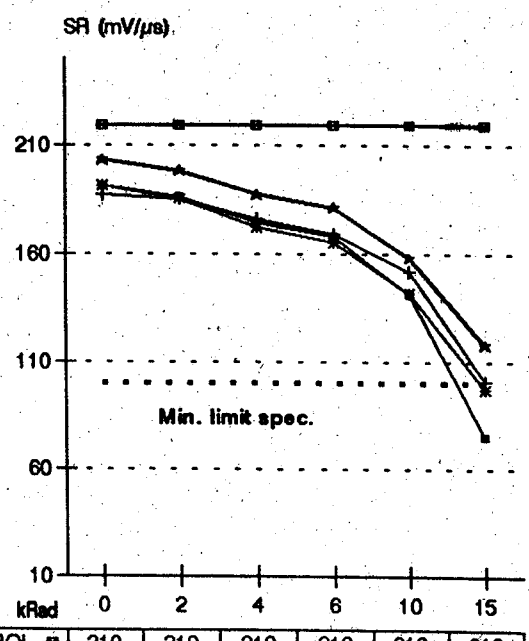
CONTROL	214	214	214	214	214	214
R1	194	192	180	172	152	115
R2	190	187	175	166	145	101
R3	194	187	174	168	146	103
R4	187	181	175	167	151	93

OP400AY
Slew Rate- (AVCL=+1)(#2)



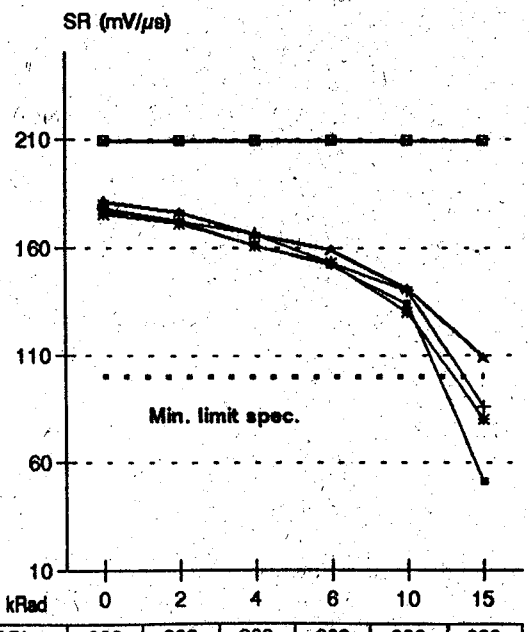
CONTROL	208	208	208	208	208	208
R1	186	181	170	164	144	108
R2	173	168	157	149	126	75
R3	180	175	163	156	139	79
R4	175	171	164	154	139	102

OP400AY
Slew Rate- (AVCL=+1) (#3)



CONTROL	219	219	219	219	219	219
R1	203	198	187	181	158	118
R2	191	185	172	165	142	97
R3	191	186	174	168	141	75
R4	187	185	176	169	152	101

OP400AY
Slew Rate- (AVCL=+1) (#4)



CONTROL	209	209	209	209	209	209
R1	181	176	166	159	141	109
R2	175	171	161	153	130	80
R3	177	172	161	152	134	51
R4	178	172	166	153	140	86