ESA-QCA0068T-C

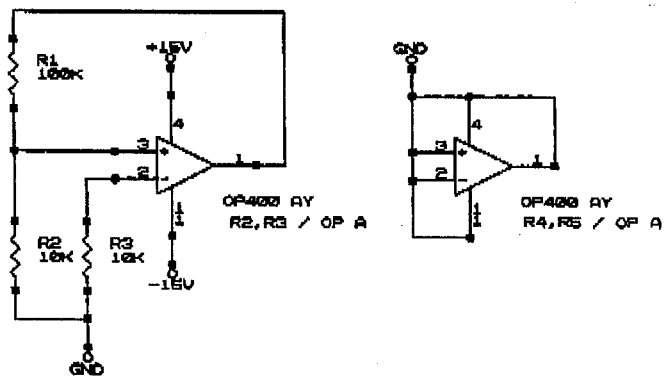
Tecnologica	**TOTAL DOSE RADIATION TEST REPORT No. HUY-RR-TL-038**	**Issue: 1 Rev.:** **Date: 28/11/94** **Page: 1/23**

SCC Component No.: HUYTL05503B		**Component Designation:** OP400 AY	**Irradiation Spec. No.:** ESA/SCC 22900 Iss. 3
Gen. Spec.: SCC 9000 8 **Det. Spec.:** HUY-SP-TL-055 1 **Amend.:**		**Evaluation:** - **Acceptance Difussion:** - **Acceptance Lot:** X	**Project/Programme:** HUYGENS
Family: 08	**Group:** 09	**Functional Assignment:** QUAD OPERATIONAL AMPLIFIER	**Package:** DIL 14
Manuf.Name: Analog Devices **Address:** SANTA CLARA (USA)		**Irradiation Facility:** CIEMAT **Address:** MADRID (SPAIN)	**Test House:** TECNOLOGICA **Address:** MADRID (SPAIN)
Radiation Test Plan No.: HUY-IP-TL-038		**Sample Size:** 5 **Irradiation Devices:** 4 **Control Devices:** 1	**Date Code:** 9342 **Diffusion LOT:** 2F12250.1 **Wafer N°:** 9, 22
Radiation Source: Cobalt-60		**Energy:** 1,33/1,17 MeV **Average Dose Rate:** 10,263 Krad/h	**Date of Test:** 11/94

Electrical Measurements. Parameters Tested:
Input Offset Voltage (V_{OS}), Input Offset Current (I_{OS}), Input Bias Current (I_B), Power Supply Rejection Radio (PSRR), Large Signal Voltage Gain 1 (A_{VO1}), Large Signal Voltage Gain 2 (A_{VO2}), Supply Current (I_S) and Slew Rate (SR+ & SR-).

Irradiation Conditions: **Biased:** Y **Test Circuit:** Figure 1	**Irradiation Measurements Interval:** **Biased:** N **Test Circuit:** N/A	**Annealing Tests:** YES **Biased:** Y **Time:** 90h / 96h **Temp.:** 25°C / 25°C **Test Circuit:** Figure 1

Figure 1:



Irradiat. Respons.: J. VAQUERO **Date:** 28/11/94 **Signature:**	**Electr. Test Resp.:** J.M VALVERDE **Date:** 29/11/94 **Signature:**	**Approved by QA:** J. ALARCON **Date:** 30/11/94 **Signature:**

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SUMMARY

Total dose steady-state irradiation test has been carried out on **QUAD OPERATIONAL AMPLIFIER OP400AY** from **Analog Devices** date code 9342, Diffusion Lot 2F12250.1 and wafer N° 9, 22. The irradiated parts were labelled as follows: R2= S/N 206, R3= S/N 207, R4= S/N 209, R5= S/N 210, irradiation devices and R1= S/N 201 control device.

DEVIATIONS TO THE PLAN

Irradiation test has been performed at 5, 10, 15, 20 and 30 Krads. in order to better characterize the lot.

First annealing measurements has been done at 90h after irradiation.

RESULTS

The next table shows a results resume of the irradiation test:

	00 KRAD	5 KRAD	10 KRAD	15 KRAD	20 KRAD	30 KRAD	ANN1	ANN2
VOS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
IOS	PASS	PASS	PASS	PASS	PASS	PASS	PASS 13 FAIL 3	PASS 14 FAIL 2
IB	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
PSRR	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
AVO1	PASS	PASS	PASS 1 FAIL 15	FAIL	FAIL	FAIL	FAIL	FAIL
AVO2	PASS	PASS	PASS	PASS	PASS 7 FAIL 9	FAIL	PASS 8 FAIL 8	PASS 8 FAIL 8
IS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
SR+	PASS	PASS 14 FAIL 2	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
SR-	PASS	PASS	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

CONCLUSION

The results indicates that:

- Input offset current measurements pass during all irradiation steps but fail during annealing in one device (R5) biased with second bias circuit.

- Input bias current measurements fail at 10 Krads on all op amp and recover slightly during annealing. Operational biased with second circuit are more affected during the test.

- PSRR measurements fail at 10 Krads on all op amp and recover during annealing. Operational biased with second circuit are more affected during the test and have worse recover during annealing.

- Open loop gain measurements have low dependence with biasing circuit:
AVO1 fails at 10 Krads in all op amp and recover during annealing in first bias circuit.
AVO2 fails between 20 and 30 Krads and recover under spec during annealing in first bias circuit.

- Slew rate measurements fail between 5 and 10 Krads and don't recover during annealing in both bias circuits.

- All other measurements remains under spec during all the irradiation test.

SCHEDULE

Test Step	Description	Result or Actual Test Condition	Time in	Time Out	Exposure
1	Sample serialization	CONTROL R1. IRR. DEVICES R2,R3,R4,R5.			
2	Initial Electrical Measurements	See 0 krad(Si) values in respective Parameter Data Tables Temperature: 20,1°C Humidity: 40,2%	08:45 17/11	09:20 17/11	35 min.
3	Set-up of Test	Bias circuit verified according to Fig. 1			
4	Irradiation Exposure	Dose: 5,145 Krad(Si) Cumulative Dose: 5,145 Krad(Si) Dose Rate: 10,29 Krad(Si)/h Temperature: 23,7 °C	09:35	10:05	30 min.
5	Intermediate Electrical Measurements	See 5 Krad(Si) values in respective Parameter Data Tables Temperature: 21,7°C Humidity: 36,8%	10:10	10:31	21 min.
6	Set-up of Test	Bias circuit verified according to Fig. 1			
7	Irradiation Exposure	Dose: 5,14 Krad(Si) Cumulative Dose: 10,285 Krad(Si) Dose Rate: 10,28 Krad(Si)/h Temperature: 23,5°C	10:40	11:10	30 min.
8	Intermediate Electrical Measurements	See 10 krad(Si) values in respective Parameter Data Tables Temperature: 21,9°C Humidity: 37,5%	11:15	11:40	25 min.
9	Set-up of Test	Bias circuit verified according to Fig. 1			
10	Irradiation Exposure	Dose: 5,105 Krad(Si) Cumulative Dose: 15,39 krad(Si) Dose Rate: 10,21 Rad(Si)/h Temperature: 23,6°C	11:45	12:15	30 min.

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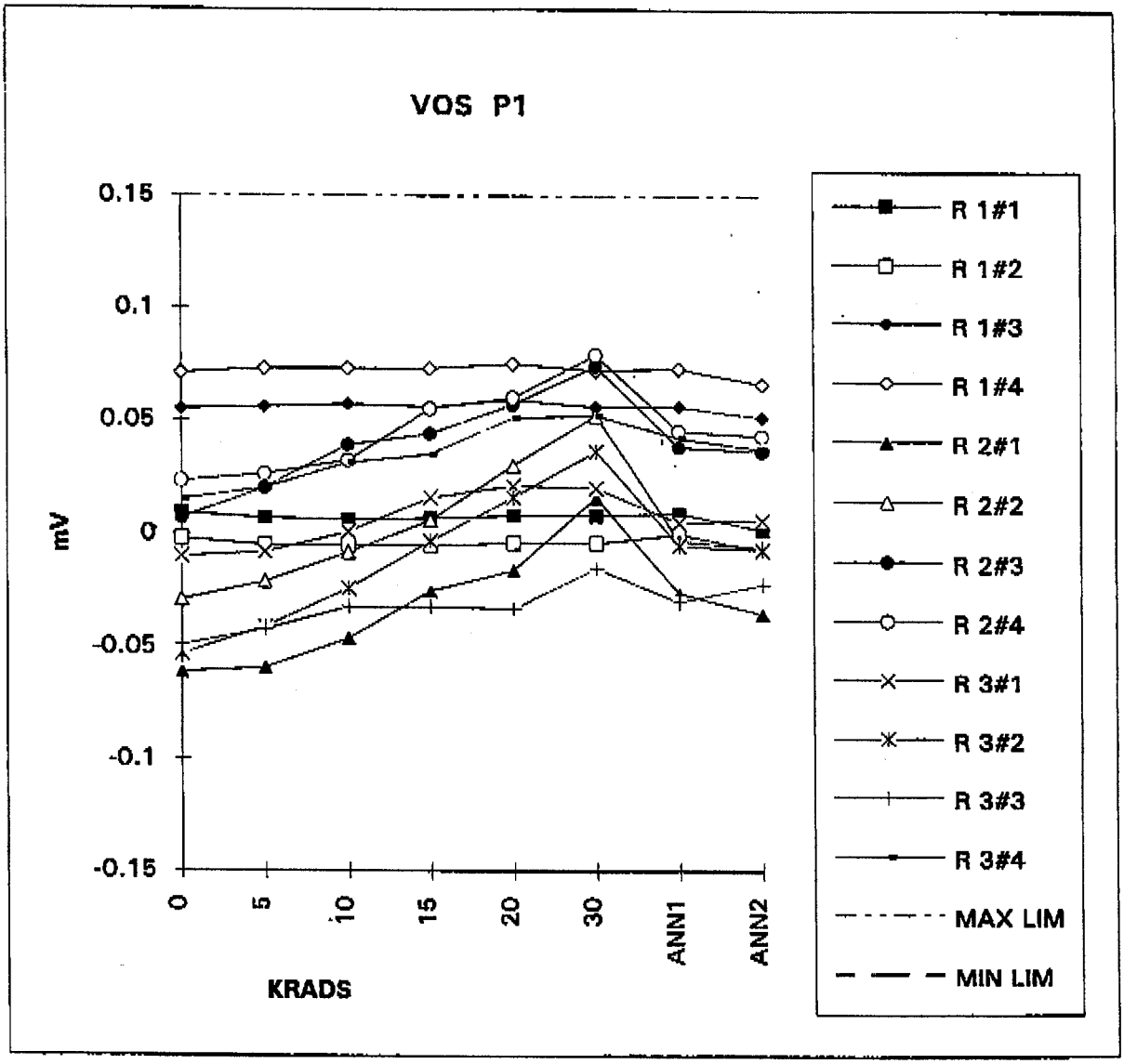
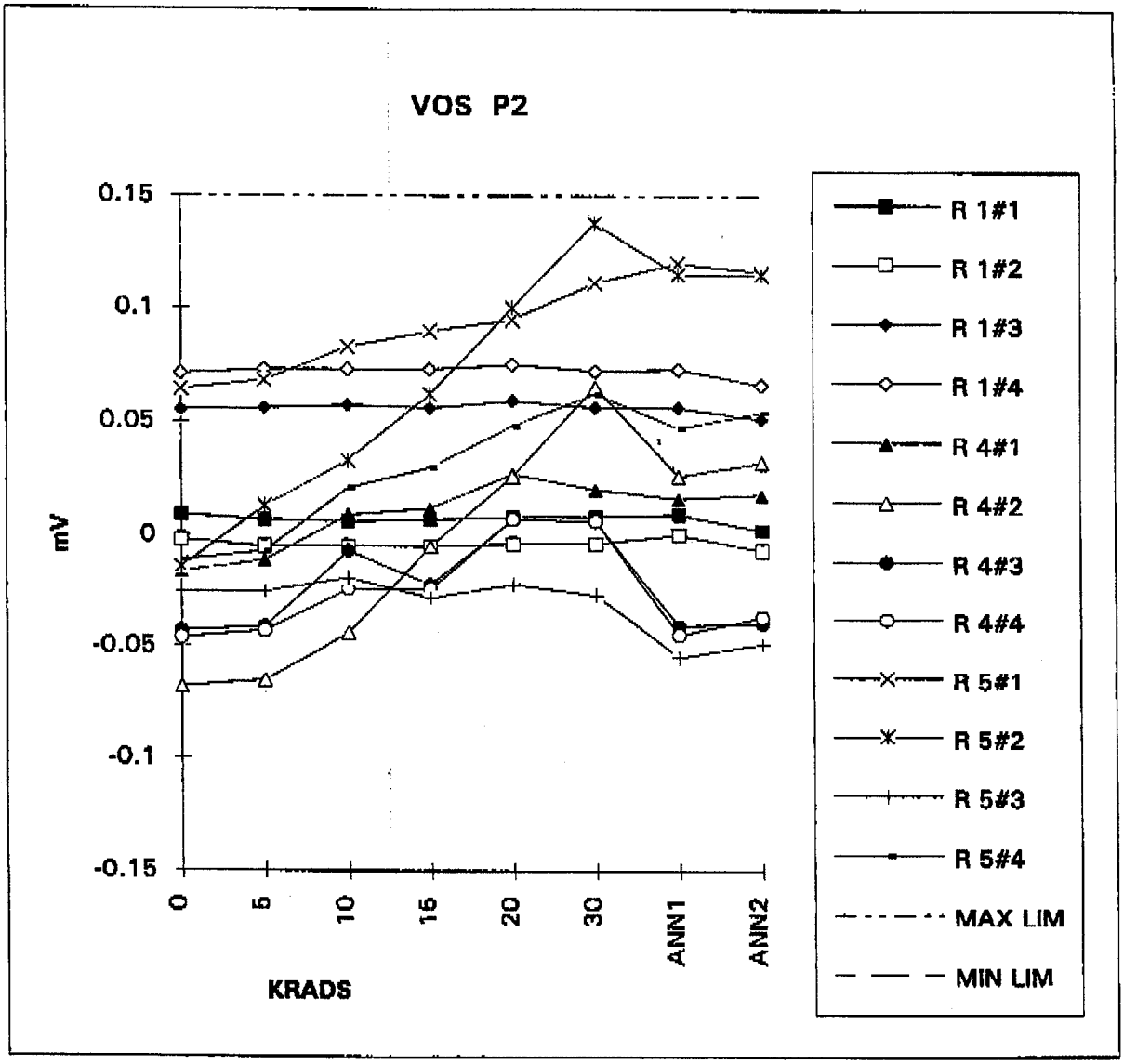
Test Step	Description	Result or Actual Test Condition	Time in	Time Out	Exposure
11	Intermediate Electrical Measurements	See 15 Krad(Si) values in respective Parameter Data Tables Temperature: 22,5°C Humidity: 35,5%	12:20	12:35	15 min.
12	Set-up of Test	Bias circuit verified according to Fig. 1			
13	Irradiation Exposure	Dose: 5,105 Krad(Si) Cumulative Dose: 20,495 Krad(Si) Dose Rate: 10,21 Rad(Si)/h Temperature: 23,7°C	12:45	13:15	30 min.
14	Intermediate Electrical Measurements	See 20 Krad(Si) values in respective Parameter Data Tables Temperature: 22,5°C Humidity: 35,8%	13:20	13:40	20 min.
15	Set-up of Test	Bias circuit verified according to Fig. 1			
16	Irradiation Exposure	Dose: 10,24 Krad(Si) Cumulative Dose: 30,735 Krad(Si) Dose Rate: 10,24 Rad(Si)/h Temperature: 23,7°C	13:46	14:46	60 min.
17	Intermediate Electrical Measurements	See 30 Krad(Si) values in respective Parameter Data Tables Temperature: 22,1°C Humidity: 40.6%	14:55	15:50	55 min.
18	Annealing	Bias circuit verified according to Fig. 1. Temperature: 19,5°C (average)	16:00 17/11	08:30 21/11	89:30 h.
19	Electrical Measurements	See Ann1 values in respective Parameter Data Tables Temperature: 16,6 °C Humidity: 43.1%	08:30	09:20	50 min.
20	Annealing	Bias circuit verified according to Fig. 1. Temperature: 18°C (average)	09:20 21/11	09:20 25/11	96 h.

Test Step	Description	Result or Actual Test Condition	Time in	Time Out	Exposure
21	Electrical Measurements	See Ann2 values in respective Parameter Data Tables Temperature: 20°C Humidity: 40,6%	09:30	10:30	60 min.



VOS P1	0	5	10	15	20	30	ANN1	ANN2
R1#1	0.009	0.007	0.006	0.007	0.008	0.008	0.009	0.002
R1#2	-0.002	-0.005	-0.005	-0.005	-0.004	-0.004	0	-0.007
R1#3	0.055	0.056	0.057	0.056	0.059	0.056	0.056	0.051
R1#4	0.071	0.073	0.073	0.073	0.075	0.072	0.073	0.066
R2#1	-0.061	-0.059	-0.046	-0.025	-0.016	0.016	-0.026	-0.035
R2#2	-0.029	-0.021	-0.008	0.006	0.03	0.052	-0.003	-0.006
R2#3	0.007	0.02	0.039	0.044	0.057	0.074	0.038	0.036
R2#4	0.023	0.026	0.032	0.055	0.06	0.079	0.045	0.043
R3#1	-0.01	-0.008	0.001	0.016	0.021	0.02	0.005	0.006
R3#2	-0.053	-0.041	-0.024	-0.003	0.016	0.036	-0.005	-0.007
R3#3	-0.049	-0.042	-0.032	-0.032	-0.033	-0.015	-0.03	-0.022
R3#4	-0.015	-0.02	-0.031	-0.035	-0.051	-0.052	-0.04	-0.037
MAX LIM	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
MIN LIM	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15



VOS P2	0	5	10	15	20	30	ANN1	ANN2
R1#1	0.009	0.007	0.006	0.007	0.008	0.008	0.009	0.002
R1#2	-0.002	-0.005	-0.005	-0.005	-0.004	-0.004	0	-0.007
R1#3	0.055	0.056	0.057	0.056	0.059	0.056	0.056	0.051
R1#4	0.071	0.073	0.073	0.073	0.075	0.072	0.073	0.066
R4#1	-0.016	-0.011	0.009	0.012	0.027	0.02	0.016	0.018
R4#2	-0.068	-0.065	-0.044	-0.005	0.026	0.065	0.026	0.032
R4#3	-0.043	-0.041	-0.007	-0.022	0.007	0.006	-0.041	-0.04
R4#4	-0.046	-0.043	-0.024	-0.024	0.007	0.006	-0.045	-0.037
R5#1	0.064	0.068	0.083	0.09	0.095	0.111	0.12	0.116
R5#2	-0.014	0.013	0.033	0.062	0.1	0.138	0.115	0.115
R 5#3	-0.025	-0.025	-0.019	-0.028	-0.022	-0.027	-0.055	0.049
R 5#4	-0.011	-0.037	-0.021	-0.03	-0.048	-0.032	-0.047	-0.054
MAX LIM	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
MIN LIM	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15

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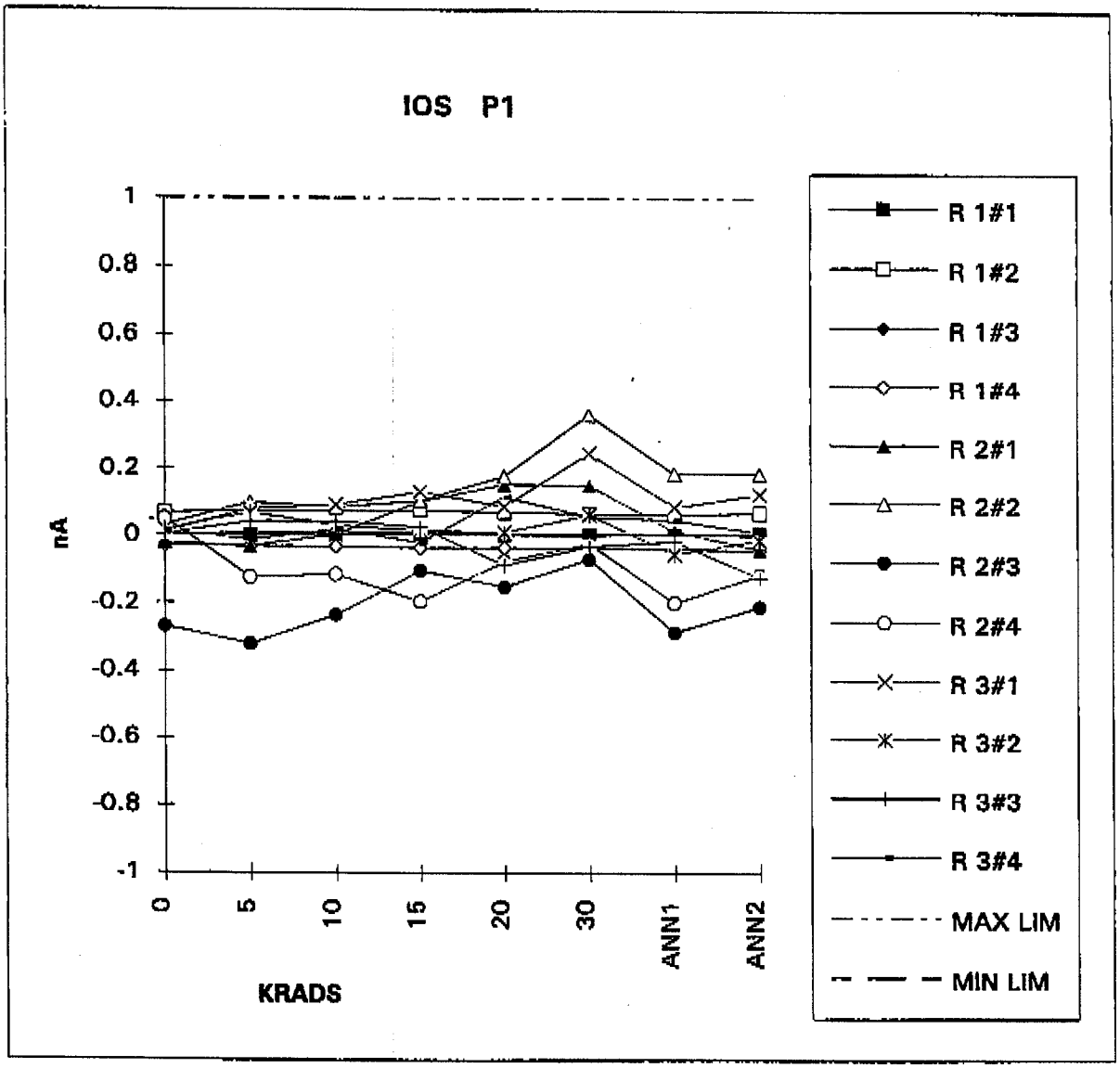
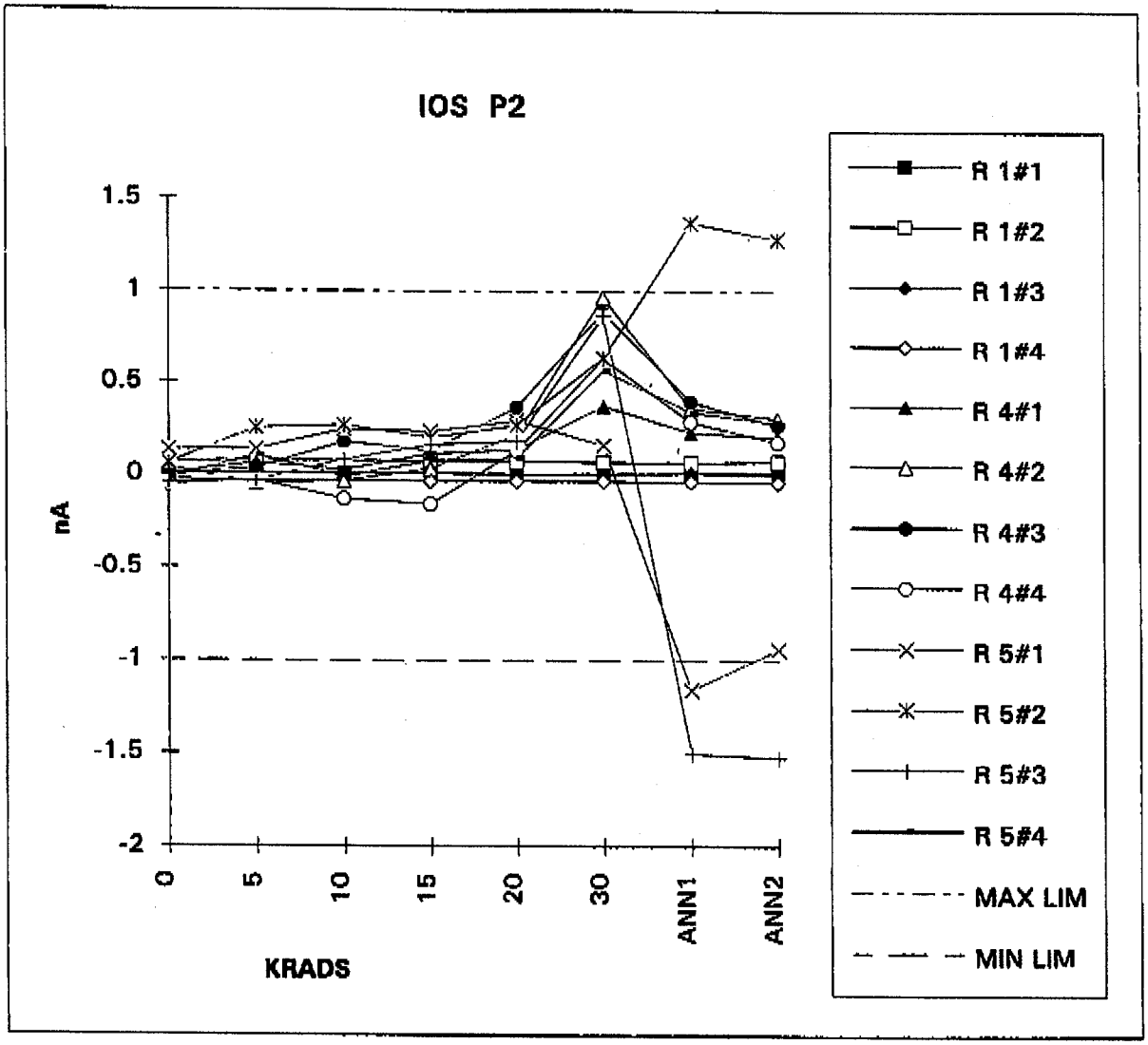
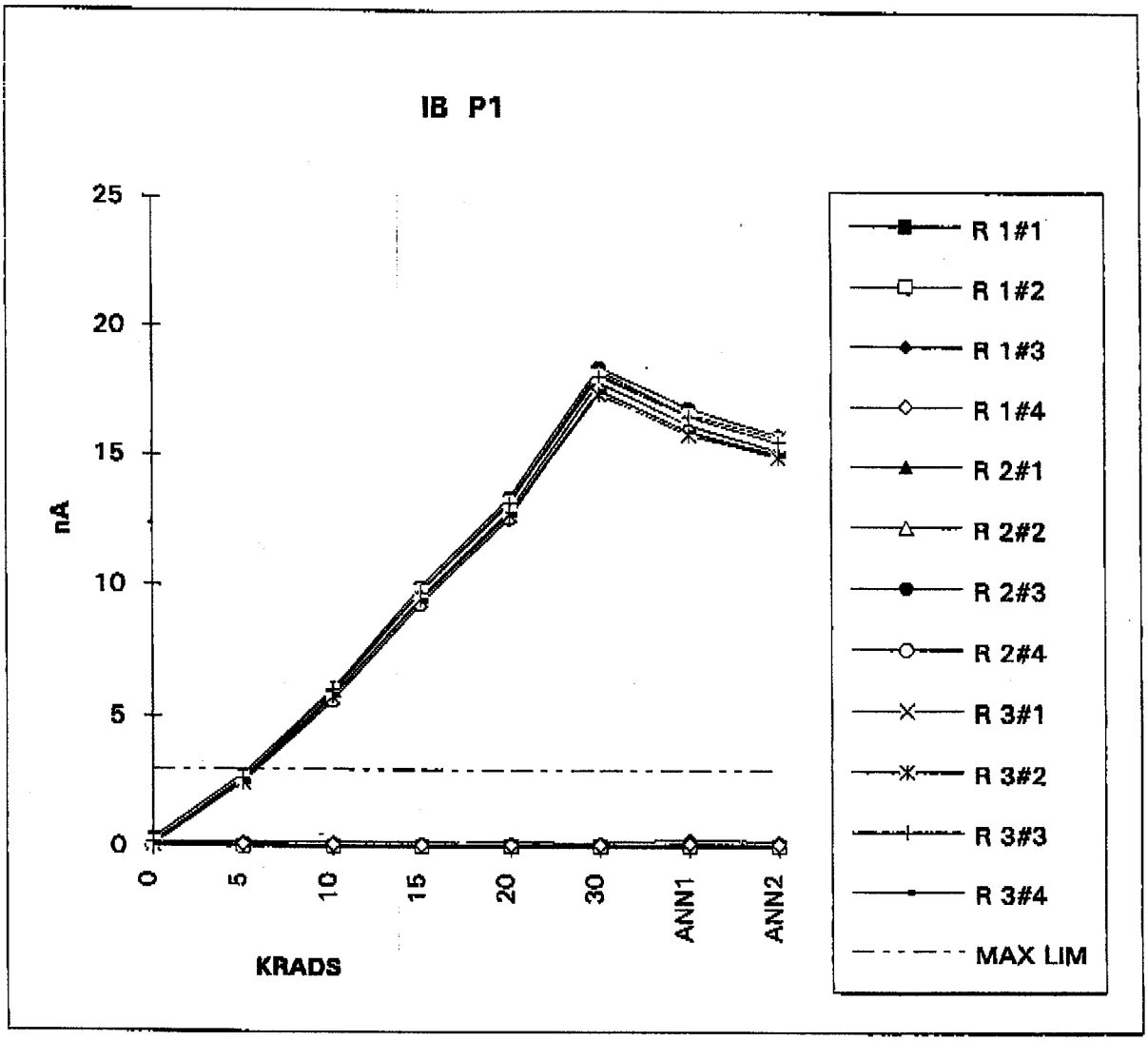


IOS P1	0	5	10	15	20	30	ANN1	ANN2
R1#1	0.001	0.002	0	0.004	0.001	0.002	0.003	0.005
R1#2	0.067	0.072	0.072	0.073	0.067	0.064	0.061	0.067
R1#3	-0.003	0.009	0.005	0.008	0.001	0.001	0.004	-0.001
R1#4	-0.031	-0.033	-0.034	-0.037	-0.037	-0.038	-0.04	-0.044
R2#1	-0.022	-0.033	0.003	0.1	0.151	0.148	0.012	-0.04
R2#2	0.031	0.098	0.083	0.103	0.176	0.36	0.184	0.184
R2#3	-0.27	-0.321	-0.236	-0.105	-0.152	-0.071	-0.285	-0.21
R2#4	0.049	-0.124	-0.116	-0.195	-0.079	-0.025	-0.198	-0.116
R3#1	0.011	0.078	0.09	0.13	0.085	0.245	0.084	0.123
R3#2	0.018	0.067	0.029	0.014	0.008	0.061	-0.056	-0.013
R3#3	0.003	0.041	0.041	0.024	-0.089	-0.033	-0.018	-0.124
R3#4	0.013	0.07	0.01	-0.022	0.113	0.065	0.0-3	0.009
MAX LIM	1	1	1	1	1	1	1	1
MIN LIM	-1	-1	-1	-1	-1	-1	-1	-1

Thalès Electronics	**TOTAL DOSE RADIATION TEST REPORT No. HUY-RR-TL-038**	**Issue: 1** **Rev.:** **Date: 28/11/94** **Page: 10/23**



IOS P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1	0.001	0.002	0	0.004	0.001	0.002	0.003	0.005
R 1#2	0.067	0.072	0.072	0.073	0.067	0.064	0.061	0.067
R 1#3	-0.003	0.009	0.005	0.008	0.001	0.001	0.004	-0.001
R 1#4	-0.031	-0.033	-0.034	-0.037	-0.037	-0.038	-0.04	-0.044
R 4#1	0	0.061	0.024	0.11	0.132	0.371	0.226	0.199
R 4#2	0.037	-0.051	-0.035	0.03	0.213	0.968	0.357	0.302
R 4#3	-0.006	0.034	0.175	0.127	0.364	0.886	0.395	0.264
R 4#4	-0.058	-0.03	-0.133	-0.159	0.126	0.629	0.284	0.173
R 5#1	0.131	0.134	0.243	0.232	0.292	0.157	-1.161	-0.941
R 5#2	0.055	0.252	0.266	0.199	0.266	0.633	1.369	1.279
R 5#3	-0.047	-0.034	0.076	0.16	0.179	0.865	-1.503	-1.326
R 5#4	[illegible]	[illegible]	[illegible]	[illegible]	0.085	0.593	0.339	0.275
MAX LIM	1	1	1	1	1	1	1	1
MIN LIM	-1	-1	-1	-1	-1	-1	-1	-1



IB P1	0	5	10	15	20	30	ANN1	ANN2
R 1#1	0.061	0.053	0.046	0.047	0.056	0.052	0.087	0.075
R 1#2	0.061	0.049	0.044	0.046	0.056	0.052	0.081	0.065
R 1#3	0.201	0.192	0.186	0.186	0.198	0.192	0.316	0.234
R 1#4	0.121	0.106	0.098	0.098	0.109	0.105	0.149	0.127
R 2#1	0.073	2.596	5.878	9.771	13.157	18.317	16.559	15.545
R 2#2	0.103	2.667	5.761	9.54	12.855	17.86	16.22	15.214
R 2#3	0.332	2.797	6.063	9.947	13.381	18.433	16.874	15.807
R 2#4	0.139	2.477	5.633	9.308	12.603	17.555	15.952	14.991
R 3#1	0.113	2.664	6.002	9.798	13.239	18.174	16.622	15.717
R 3#2	0.076	2.506	5.754	9.465	12.728	17.397	15.843	14.953
R 3#3	0.132	2.606	5.995	9.709	13.156	18.058	16.51	15.57
R 3#4	0.1	2.507	5.797	9.444	12.709	17.525	15.96	15.03
MAX LIM	3	3	3	3	3	3	3	3

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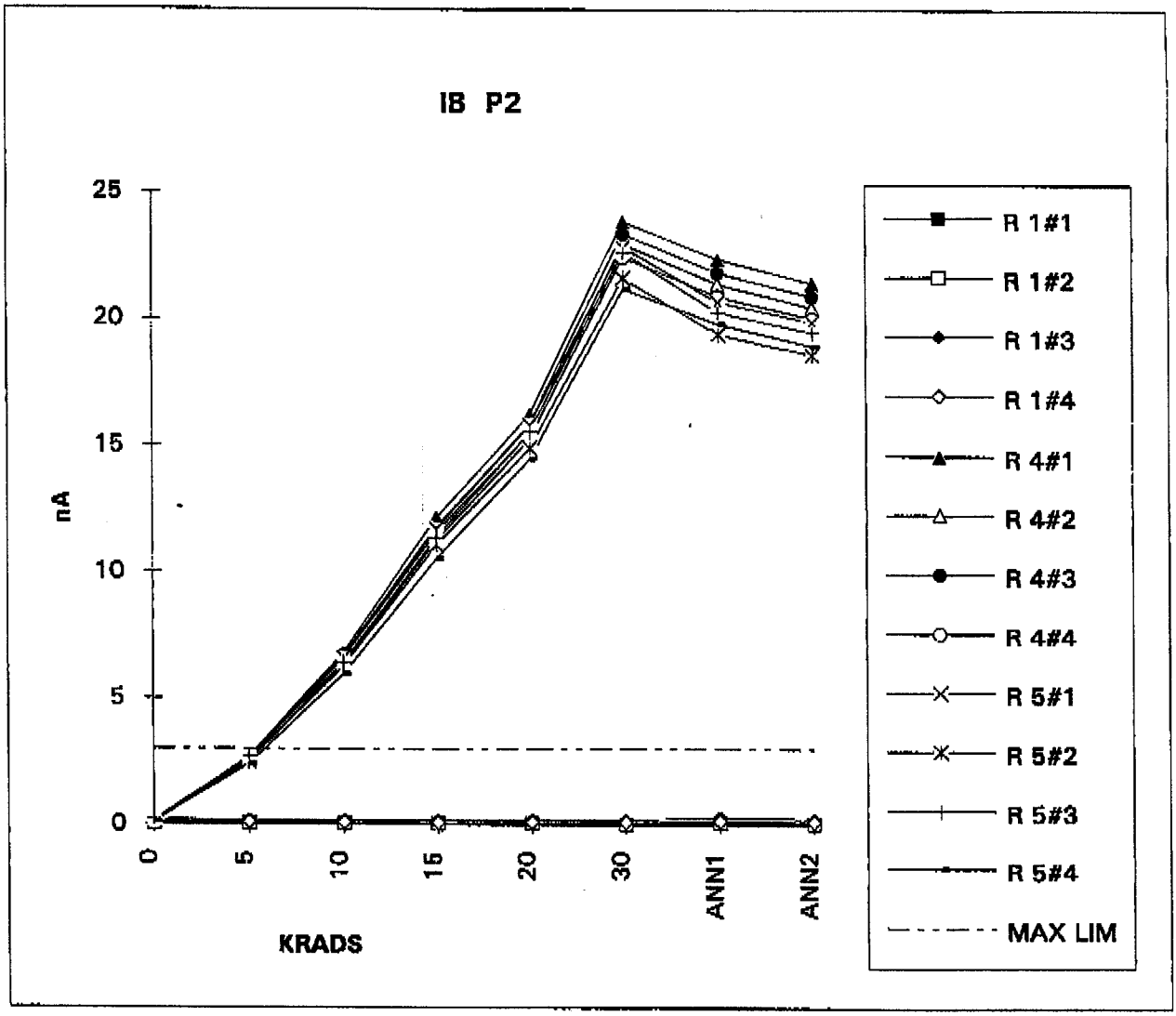
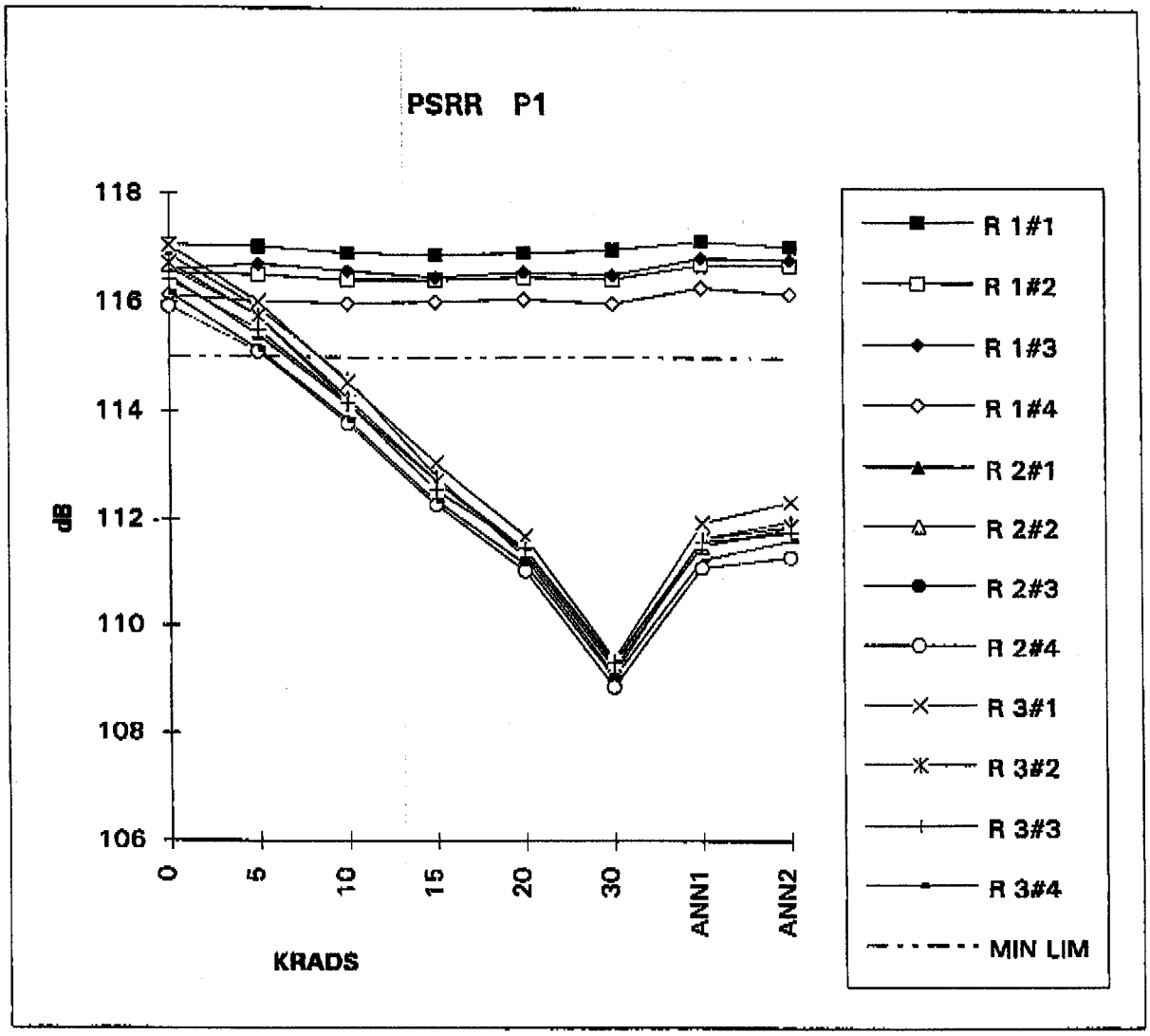
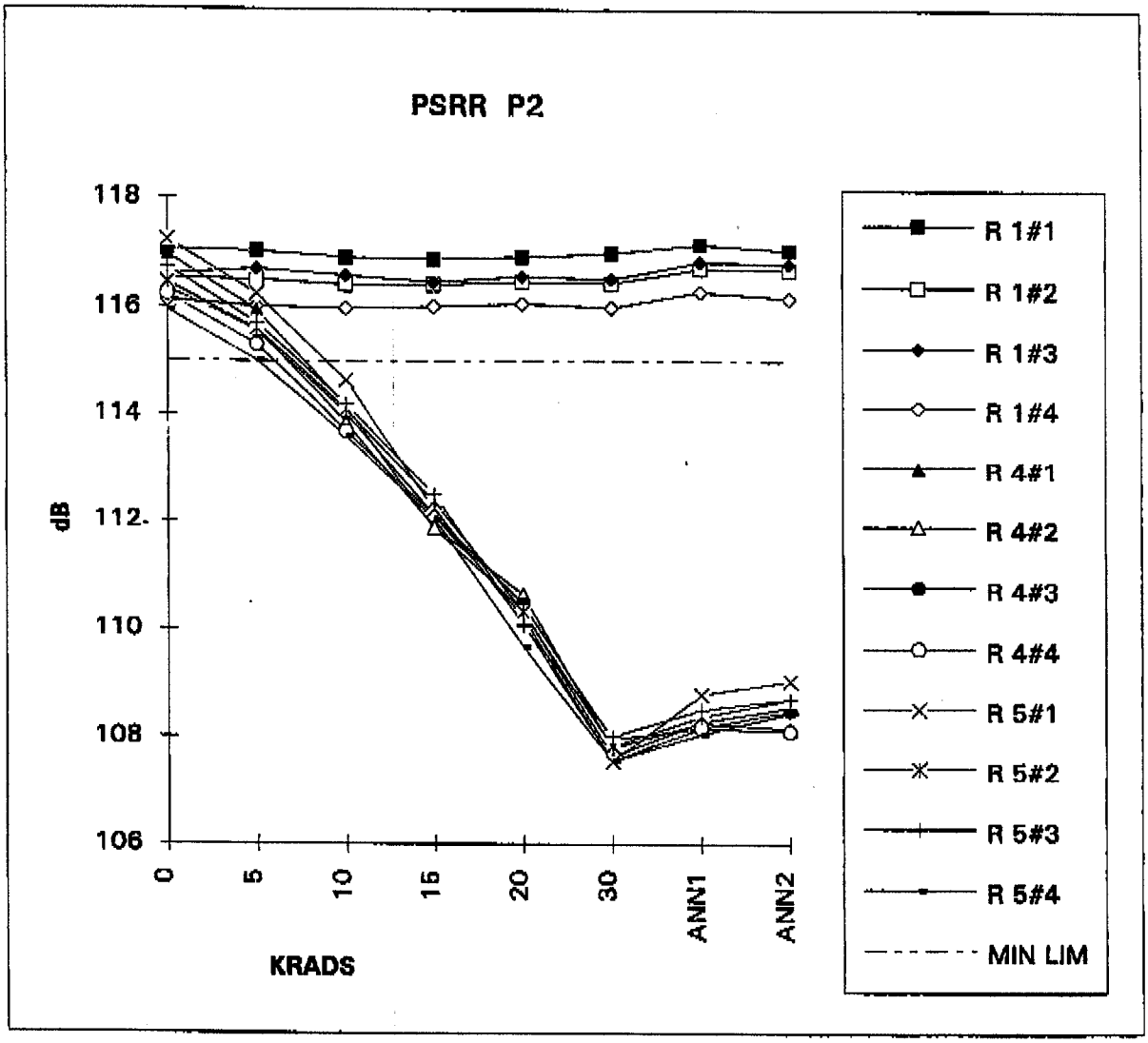


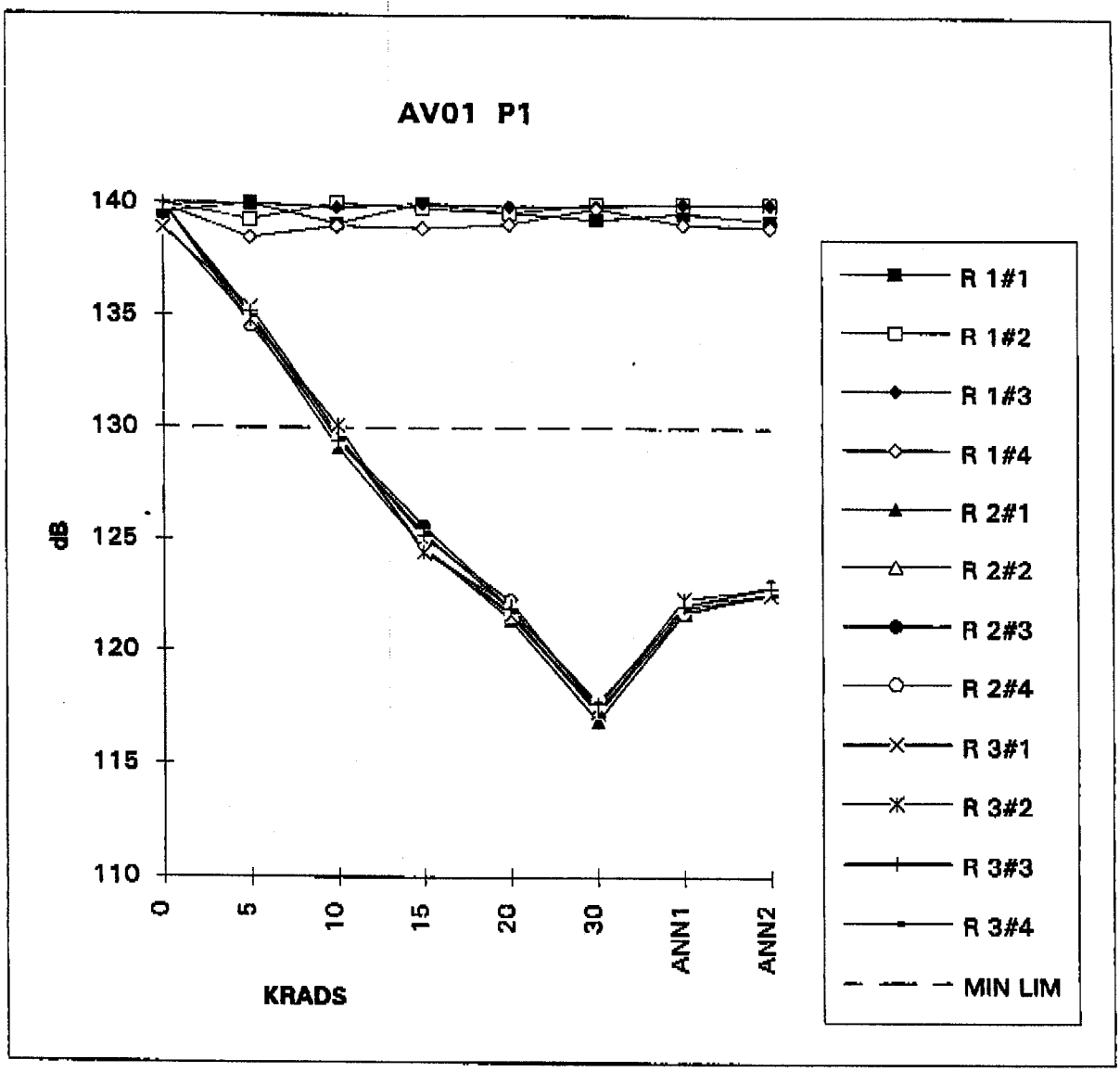
IB P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1	0.061	0.053	0.046	0.047	0.056	0.052	0.087	0.075
R 1#2	0.061	0.049	0.044	0.046	0.056	0.052	0.081	0.065
R 1#3	0.201	0.192	0.186	0.186	0.198	0.192	0.316	0.234
R 1#4	0.121	0.106	0.098	0.098	0.109	0.105	0.149	0.127
R 4#1	0.098	2.704	6.824	12.171	16.26	23.859	22.375	21.425
R 4#2	0.08	2.571	6.613	11.574	15.536	22.961	21.391	20.464
R 4#3	0.147	2.662	6.724	11.789	15.894	23.376	21.835	20.902
R 4#4	0.109	2.532	6.367	11.247	15.314	22.44	20.903	20.018
R 5#1	0.162	2.662	6.636	11.727	15.841	22.846	20.687	19.882
R 5#2	0.137	2.485	6.285	11.08	14.944	21.625	19.401	18.577
R 5#3	0.2	2.671	6.474	11.392	15.576	22.633	20.273	19.456
R 5#4	0.13	2.38	5.969	10.535	14.516	21.195	19.804	18.927
MAX LIM	3	3	3	3	3	3	3	3



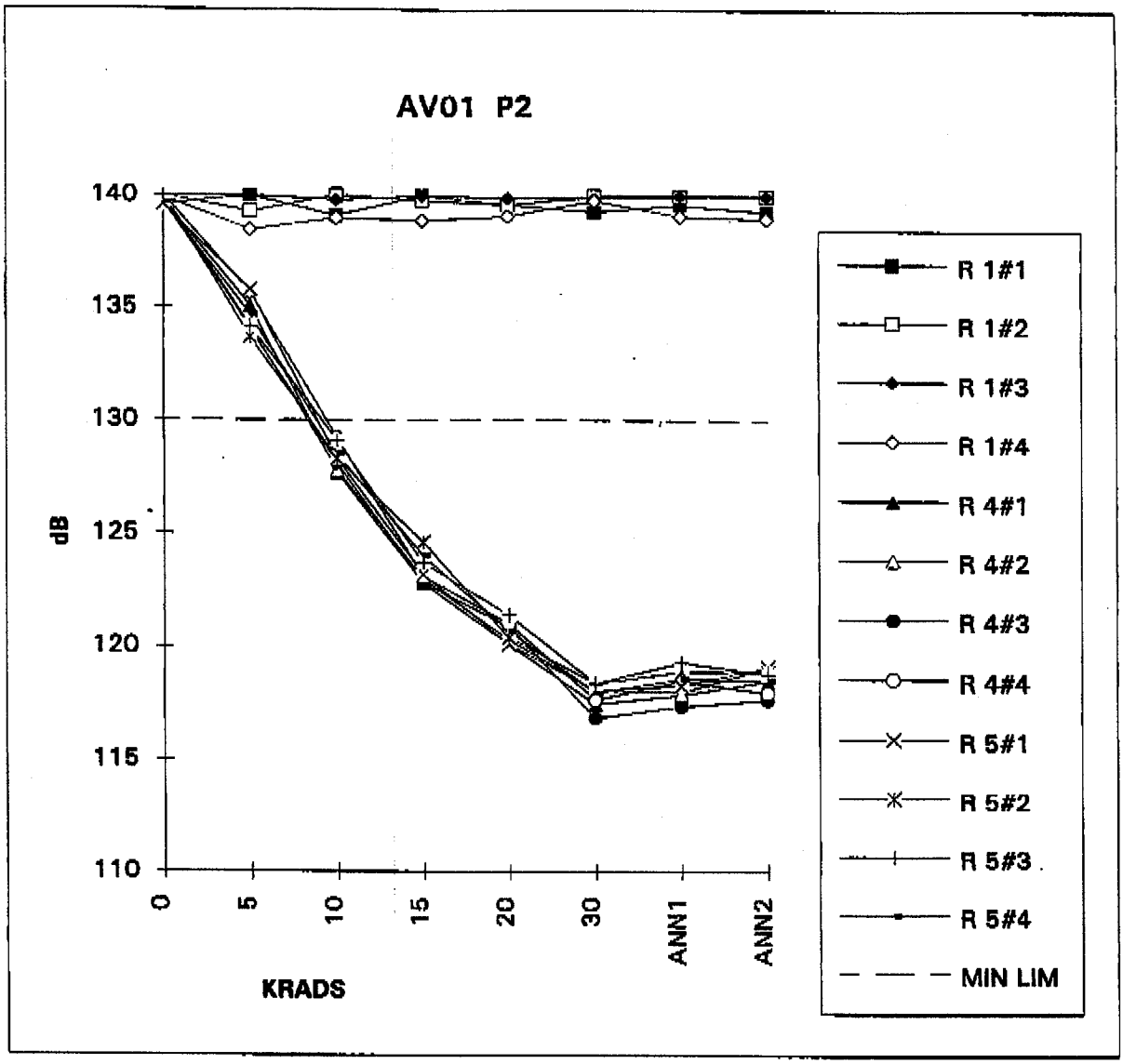
PSRR P1	0	5	10	15	20	30	ANN1	ANN2
R1#1	117.06	117.02	116.9	116.88	116.92	116.98	117.14	117.04
R1#2	116.54	116.5	116.41	116.42	116.47	116.44	116.71	116.7
R1#3	116.6	116.7	116.58	116.46	116.57	116.52	116.83	116.8
R1#4	116.13	116.02	115.98	116.02	116.07	116	116.29	116.18
R2#1	116.87	115.91	114.59	112.82	111.29	109.1	111.65	111.96
R2#2	116.63	115.76	114.24	112.74	111.44	109.34	111.5	111.85
R2#3	116.47	115.41	114.12	112.74	111.37	109.21	111.53	111.79
R2#4	115.93	115.11	113.78	112.28	111.04	108.87	111.1	111.3
R3#1	117.04	116.01	114.53	113.06	111.68	109.38	111.93	112.34
R3#2	116.72	115.75	114.16	112.73	111.44	109.28	111.64	111.88
R3#3	116.41	115.51	114.15	112.56	111.45	109.24	111.6	111.73
R3#4	116.13	115.15	113.8	112.33	111.17	109.05	111.28	111.6
MIN LIM	115	115	115	115	115	115	115	115



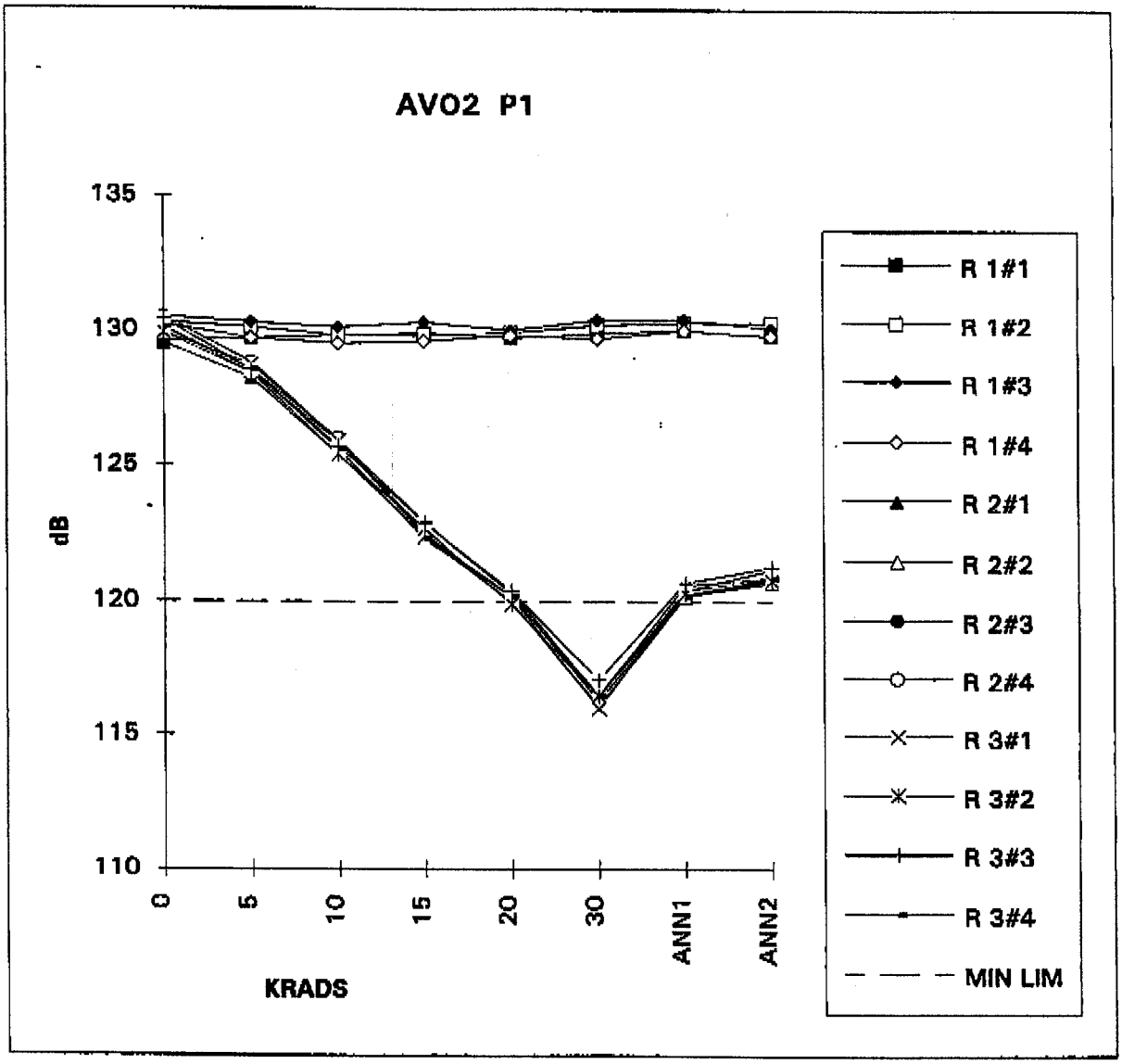
PSRR P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1	117.06	117.02	116.9	116.88	116.92	116.98	117.14	117.04
R 1#2	116.54	116.5	116.41	116.42	116.47	116.44	116.71	116.7
R 1#3	116.6	116.7	116.58	116.46	116.57	116.52	116.83	116.8
R 1#4	116.13	116.02	115.98	116.02	116.07	116	116.29	116.18
R 4#1	116.96	115.95	114.15	111.85	110.34	107.63	108.28	108.56
R 4#2	116.34	115.6	113.84	111.87	110.63	107.79	108.26	108.15
R 4#3	116.46	115.55	114.02	112.1	110.46	107.95	108.17	108.5
R 4#4	116.24	115.31	113.69	112.09	110.23	107.55	108.17	108.11
R 5#1	117.22	116.25	114.63	112.21	110.12	107.54	108.8	109.06
R 5#2	116.46	115.61	114.08	112.35	110.32	107.82	108.38	108.71
R 5#3	116.73	115.72	114.19	112.49	110.07	108.01	108.51	108.72
R 5#4	116.55	115.61	113.89	112.33	110.69	107.52	108.05	108.43
MIN LIM	115	115	115	115	115	115	115	115



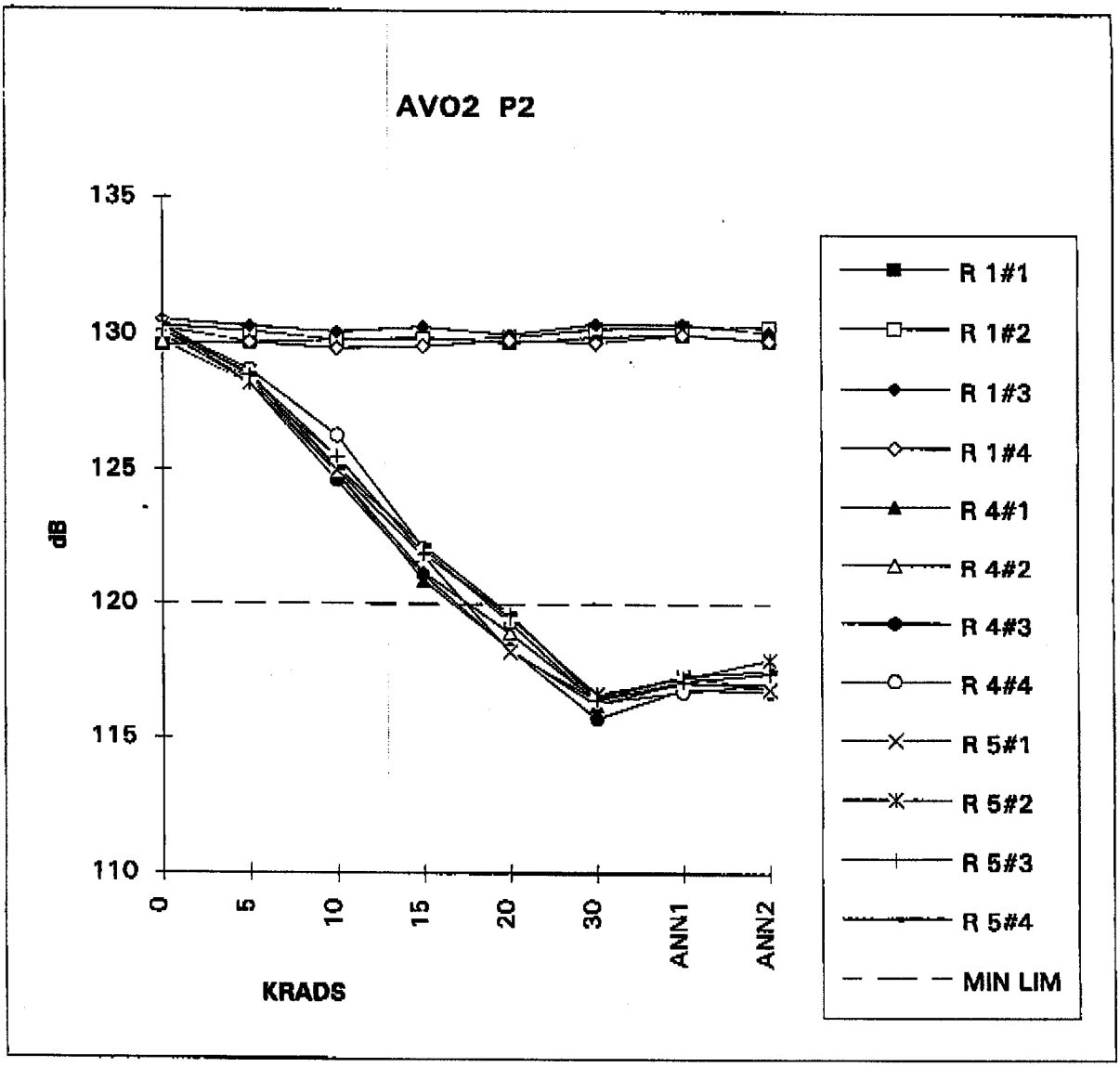
AV01 P1	0	5	10	15	20	30	ANN1	ANN2
R 1#1	139.6	140	139.1	140	139.6	139.3	139.6	139.3
R 1#2	140	139.3	140	139.8	139.6	140	140	140
R 1#3	140	140	139.8	140	139.9	139.9	140	140
R 1#4	139.9	138.5	139	138.9	139.1	139.8	139.1	139
R 2#1	139.1	134.8	129.1	124.6	121.4	116.9	121.7	122.6
R 2#2	140	135.1	129.7	124.6	121.7	117.4	121.7	122.6
R 2#3	140	135	129.5	125.6	121.9	117.6	122	122.9
R 2#4	140	134.6	129.6	125.1	122.2	117.4	121.7	122.5
R 3#1	138.9	135.4	129.7	124.5	121.6	117.3	122.1	122.5
R 3#2	140	134.8	130.1	124.4	122	117.5	122.3	122.8
R 3#3	140	135.2	129.4	125.2	121.9	117.7	122	122.5
R 3#4	140	135	129.6	125.3	121.8	117.2	121.9	122.3
MIN LIM	130	130	130	130	130	130	130	130



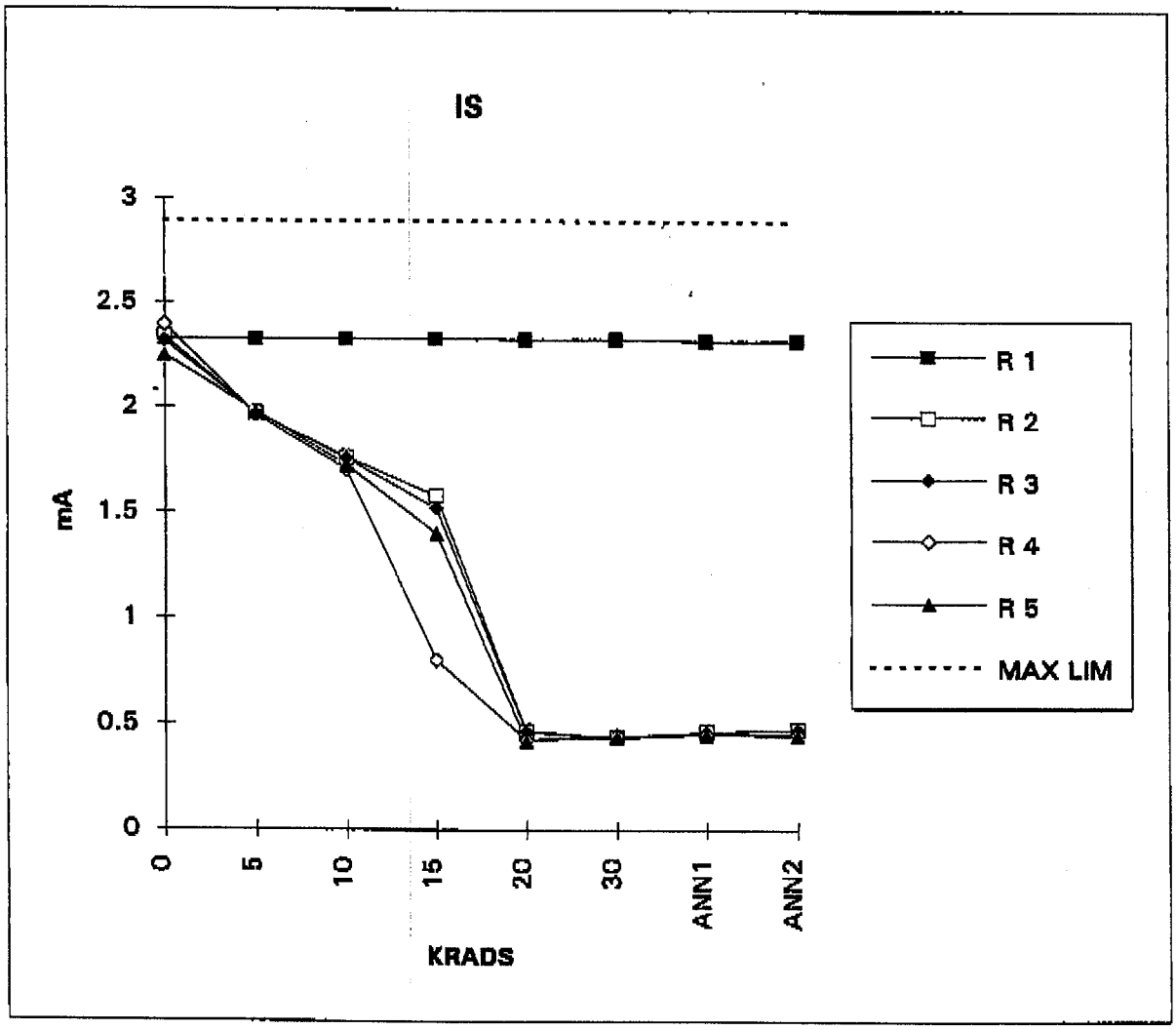
AV01 P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1	139.6	140	139.1	140	139.6	139.3	139.6	139.3
R 1#2	140	139.3	140	139.8	139.6	140	140	140
R 1#3	140	140	139.8	140	139.9	139.9	140	140
R 1#4	139.9	138.5	139	138.9	139.1	139.8	139.1	139
R 4#1	139.8	135.1	127.7	122.8	120.1	117.5	117.9	118.5
R 4#2	139.7	134.2	127.8	123	120.3	118.1	118	119.1
R 4#3	140	134.1	128.1	122.8	120.9	116.9	117.4	117.7
R 4#4	140	135.7	129.2	123.1	121	117.7	118.5	118
R 5#1	139.6	135.8	128.3	123.2	120.1	118.1	118.3	119.1
R 5#2	140	133.7	128.3	124.6	120.4	118.4	118.9	118.9
R 5#3	140	134.3	128.1	123.7	121.4	118.4	119.3	118.8
R 5#4	139.7	134.7	128.5	124	120.7	118	118.6	118.5
MIN LIM	130	130	130	130	130	130	130	130



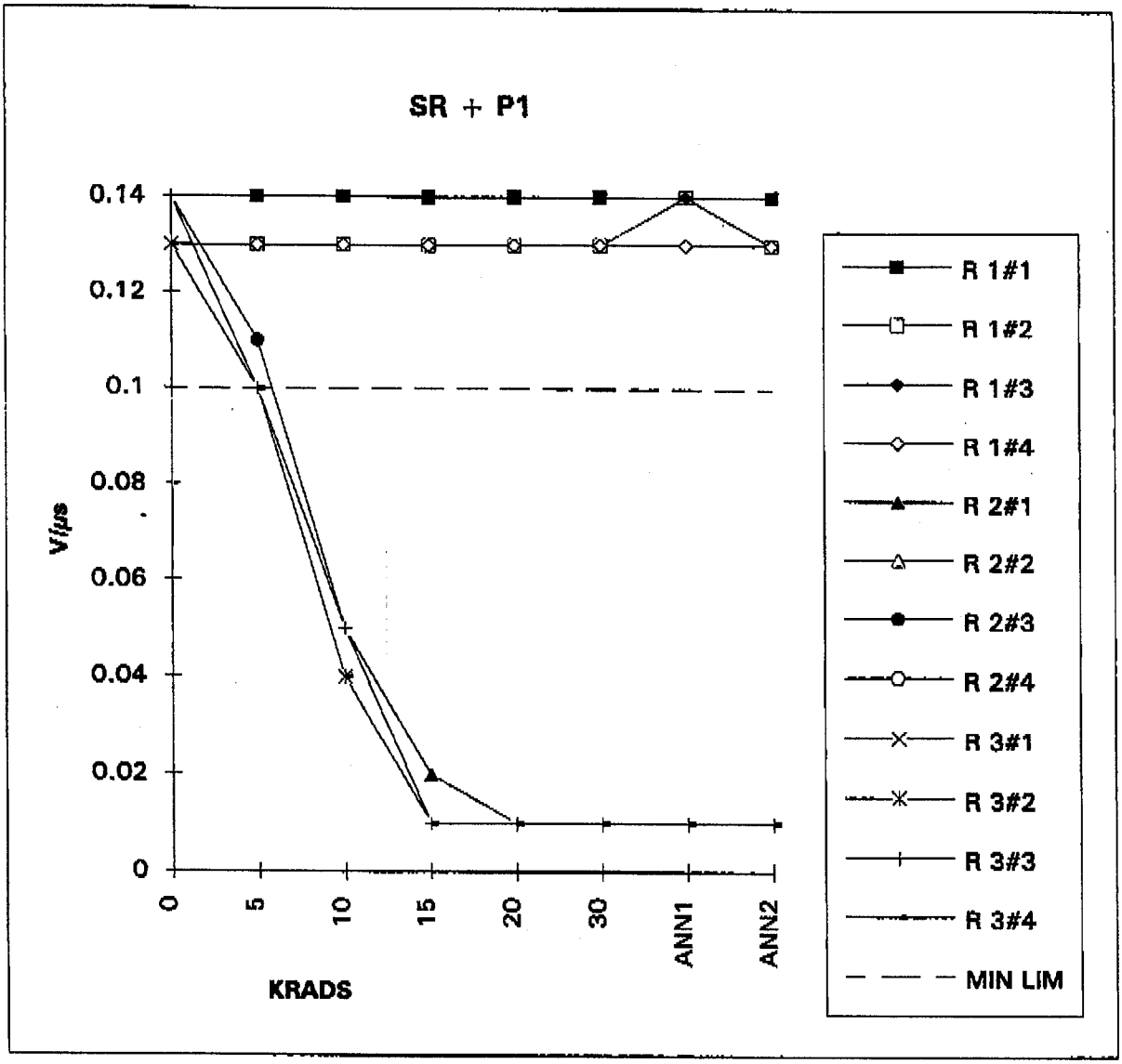
AVO2 P1	0	5	10	15	20	30	ANN1	ANN2
R 1#1	129.6	129.7	129.8	129.9	129.7	129.9	130	129.8
R 1#2	130.3	130.1	129.8	129.8	129.9	130.2	130.3	130.3
R 1#3	130.5	130.3	130.1	130.3	130	130.4	130.4	130.1
R 1#4	130.2	129.7	129.5	129.6	129.8	129.7	130	129.8
R 2#1	129.5	128.2	125.4	122.4	120	116.1	120.2	120.7
R 2#2	130.1	128.4	125.9	122.9	120.3	116.3	120.2	120.8
R 2#3	130.5	128.8	125.9	122.9	120.4	116.5	120.6	120.9
R 2#4	130.1	128.5	126	122.5	120.2	116.5	120.4	120.9
R 3#1	129.9	128.7	125.9	122.4	120.2	116	120.4	121.2
R 3#2	129.9	128.4	125.4	122.7	119.9	116.5	120.3	120.8
R 3#3	130.4	128.6	125.7	122.9	120.4	117.1	120.7	121.3
R 3#4	130.1	128.5	125.6	122.3	120.2	116.5	120.2	120.9
MIN LIM	120	120	120	120	120	120	120	120



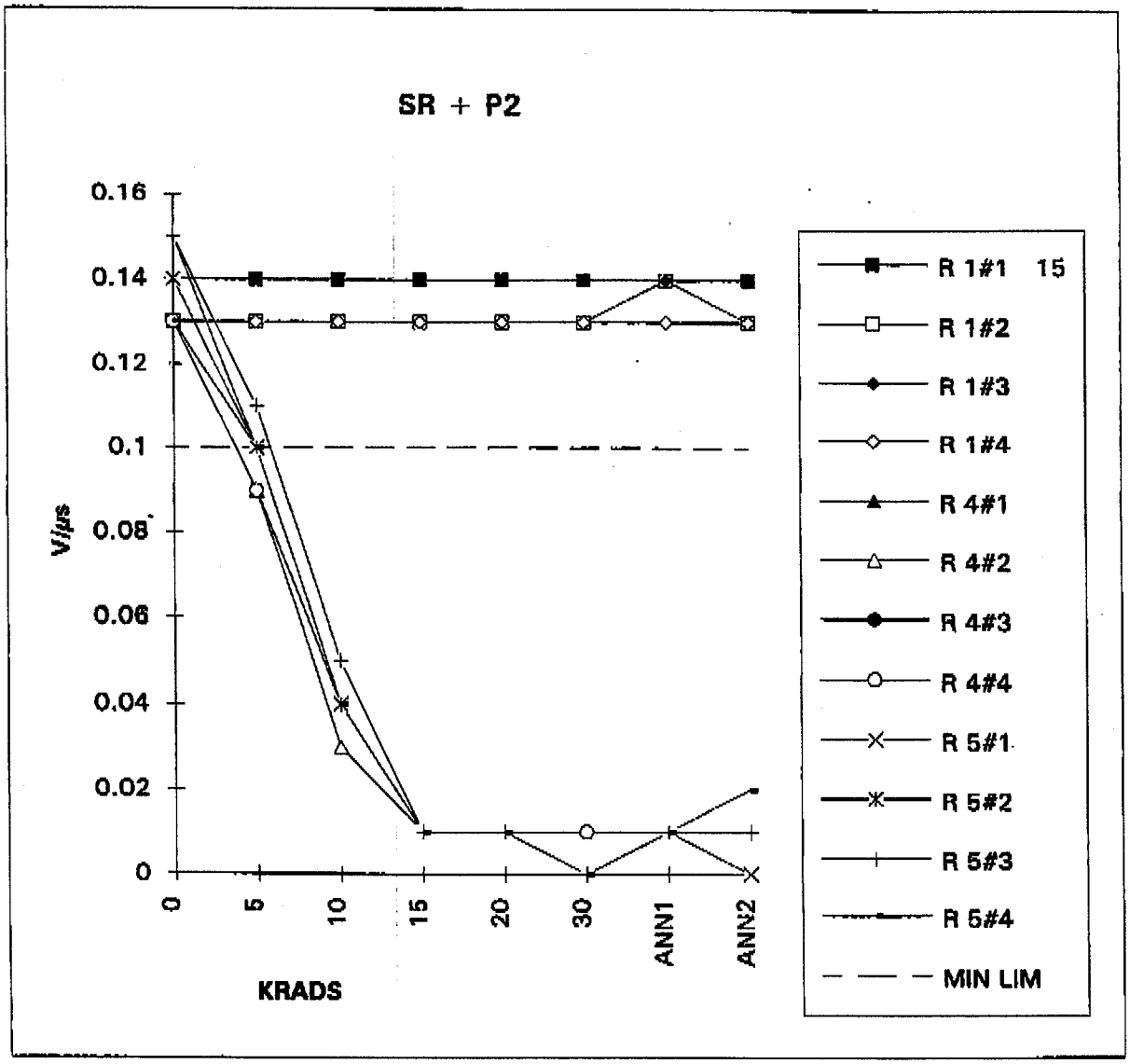
AVO2 P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1	129.6	129.7	129.8	129.9	129.7	129.9	130	129.8
R 1#2	130.3	130.1	129.8	129.8	129.9	130.2	130.3	130.3
R 1#3	130.5	130.3	130.1	130.3	130	130.4	130.4	130.1
R 1#4	130.2	129.7	129.5	129.6	129.8	129.7	130	129.8
R 4#1	129.9	128.4	124.9	120.9	118.3	116.2	117.1	116.8
R 4#2	129.7	128.2	124.9	121.2	118.9	116.4	117	117
R 4#3	130.1	128.2	124.6	121.1	118.3	115.7	116.8	116.7
R 4#4	130.2	128.7	126.3	122.1	119.3	116.3	116.7	117
R 5#1	130.1	128.6	125	121.8	118.2	116.4	117.3	116.8
R 5#2	130.3	128.2	125.5	121.9	119.5	116.6	117.2	117.9
R 5#3	130.1	128.5	125.6	121.9	119.6	116.4	117.1	117.4
R 5#4	130.3	128.6	125.3	122.2	119.6	116.5	117.3	117.5
MIN LIM	120	120	120	120	120	120	120	120



IS	0	5	10	15	20	30	ANN1	ANN2
R1	2.326	2.329	2.329	2.33	2.328	2.329	2.32	2.323
R2	2.336	1.972	1.764	1.584	0.469	0.437	0.465	0.477
R3	2.319	1.971	1.759	1.524	0.465	0.433	0.462	0.475
R4	2.395	1.967	1.706	0.806	0.428	0.449	0.454	0.453
R5	2.249	1.98	1.727	1.404	0.424	0.443	0.452	0.45
MAX LIM	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9

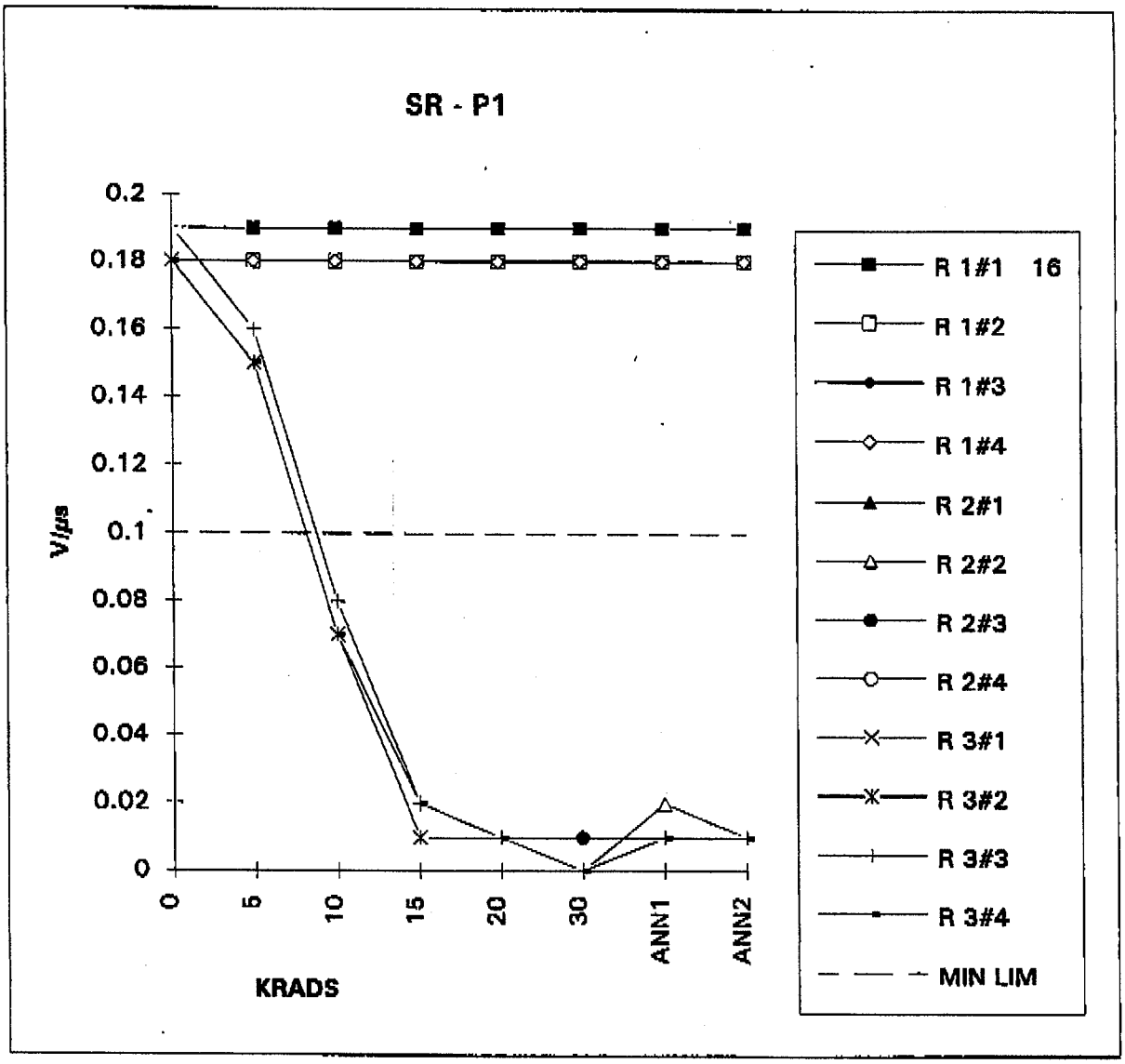


SR + P1	0	5	10	15	20	30	ANN1	ANN2
R 1#1	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
R 1#2	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.13
R 1#3	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
R 1#4	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
R 2#1	0.14	0.1	0.05	0.02	0.01	0.01	0.01	0.01
R 2#2	0.13	0.1	0.04	0.01	0.01	0.01	0.01	0.01
R 2#3	0.14	0.11	0.05	0.01	0.01	0.01	0.01	0.01
R 2#4	0.13	0.1	0.04	0.01	0.01	0.01	0.01	0.01
R 3#1	0.14	0.1	0.05	0.01	0.01	0.01	0.01	0.01
R 3#2	0.13	0.1	0.04	0.01	0.01	0.01	0.01	0.01
R 3#3	0.14	0.1	0.05	0.01	0.01	0.01	0.01	0.01
R 3#4	0.13	0.1	0.04	0.01	0.01	0.01	0.01	0.01
MIN LIM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1



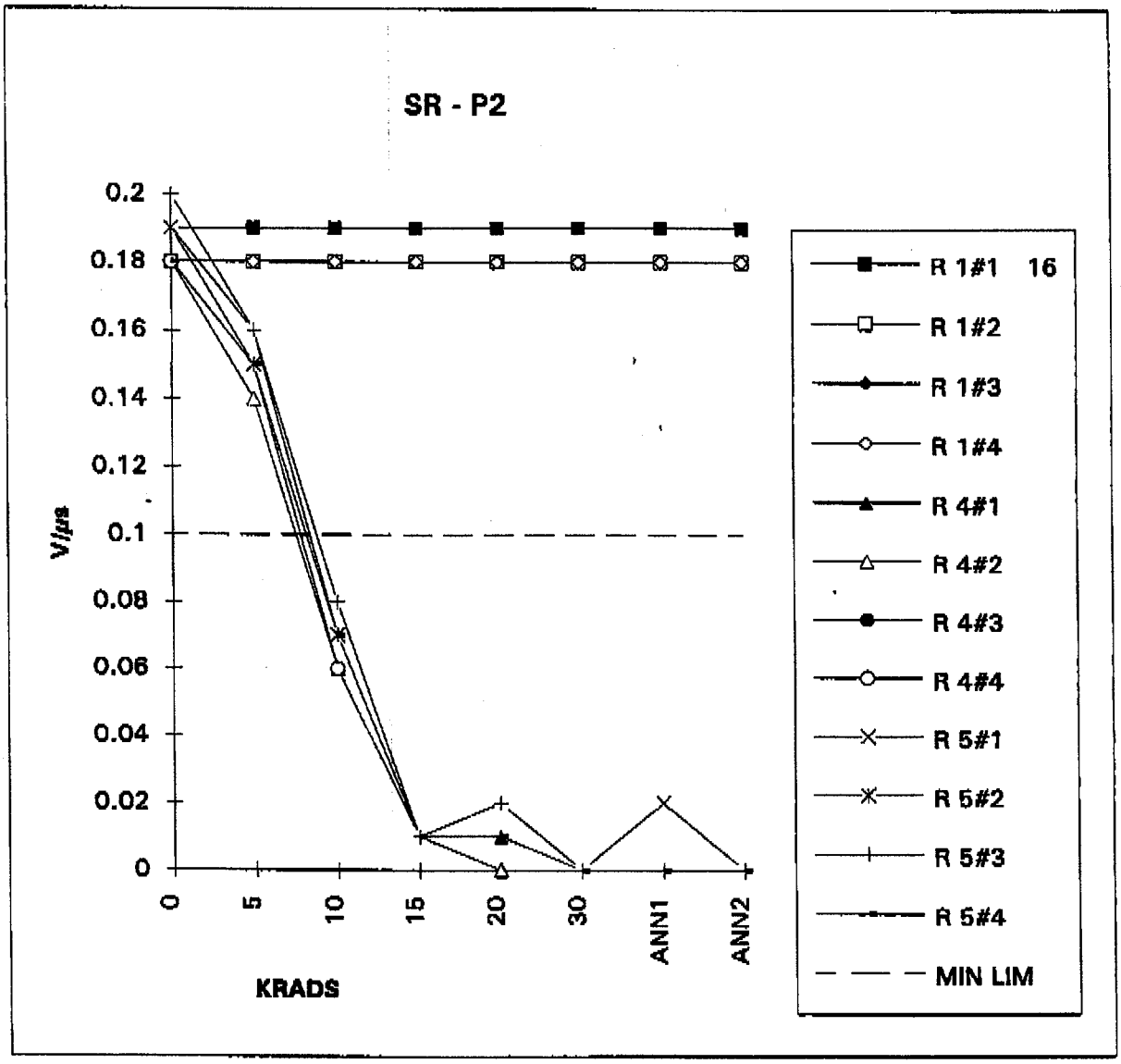
SR + P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1 15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
R 1#2	0.13	0.13	0.13	0.13	0.13	0.13	0.14	0.13
R 1#3	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
R 1#4	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
R 4#1	0.14	0.1	0.04	0.01	0.01	0	0.01	0
R 4#2	0.13	0.09	0.03	0.01	0.01	0	0.01	0.01
R 4#3	0.14	0.1	0.04	0.01	0.01	0.01	0.01	0.01
R 4#4	0.13	0.09	0.04	0.01	0.01	0.01	0.01	0.01
R 5#1	0.15	0.1	0.04	0.01	0.01	0	0.01	0
R 5#2	0.14	0.1	0.04	0.01	0.01	0	0.01	0.01
R 5#3	0.13	0.11	0.05	0.01	0.01	0	0.01	0.01
R 5#4	0.13	0.1	0.04	0.01	0.01	0	0.01	0.02
MIN LIM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Tfarologies	TOTAL DOSE RADIATION TEST REPORT No. HUY-RR-TL-038	Issue: 1 Rev.: Date: 28/11/94 Page: 22/23



SR - P1	0	5	10	15	20	30	ANN1	ANN2
R1#1 16	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
R1#2	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
R1#3	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
R1#4	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
R2#1	0.19	0.16	0.08	0.02	0.01	0	0.01	0.01
R2#2	0.18	0.15	0.07	0.02	0.01	0	0.02	0.01
R2#3	0.19	0.16	0.08	0.02	0.01	0.01	0.01	0.01
R2#4	0.18	0.15	0.07	0.02	0.01	0	0.01	0.01
R3#1	0.19	0.16	0.08	0.02	0.01	0	0.01	0.01
R3#2	0.18	0.15	0.07	0.01	0.01	0	0.01	0.01
R3#3	0.19	0.16	0.08	0.02	0.01	0	0.01	0.01
R3#4	0.18	0.15	0.07	0.02	0.01	0	0.01	0.01
MIN LIM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Télédyne	**TOTAL DOSE RADIATION TEST REPORT No. HUY-RR-TL-038**	**Issue: 1 Rev.:** **Date: 28/11/94** **Page: 23/23**



SR - P2	0	5	10	15	20	30	ANN1	ANN2
R 1#1 16	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
R 1#2	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
R 1#3	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
R 1#4	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
R 4#1	0.19	0.16	0.07	0.01	0.01	0	0	0
R 4#2	0.18	0.14	0.06	0.01	0	0	0	0
R 4#3	0.19	0.16	0.07	0.01	0.02	0	0	0
R 4#4	0.18	0.15	0.06	0.01	0.02	0	0	0
R 5#1	0.2	0.16	0.08	0.01	0.02	0	0.02	0
R 5#2	0.19	0.15	0.07	0.01	0.02	0	0	0
R 5#3	0.2	0.16	0.08	0.01	0.02	0	0	0
R 5#4	0.19	0.15	0.07	0.01	0.01	0	0	0
MIN LIM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1