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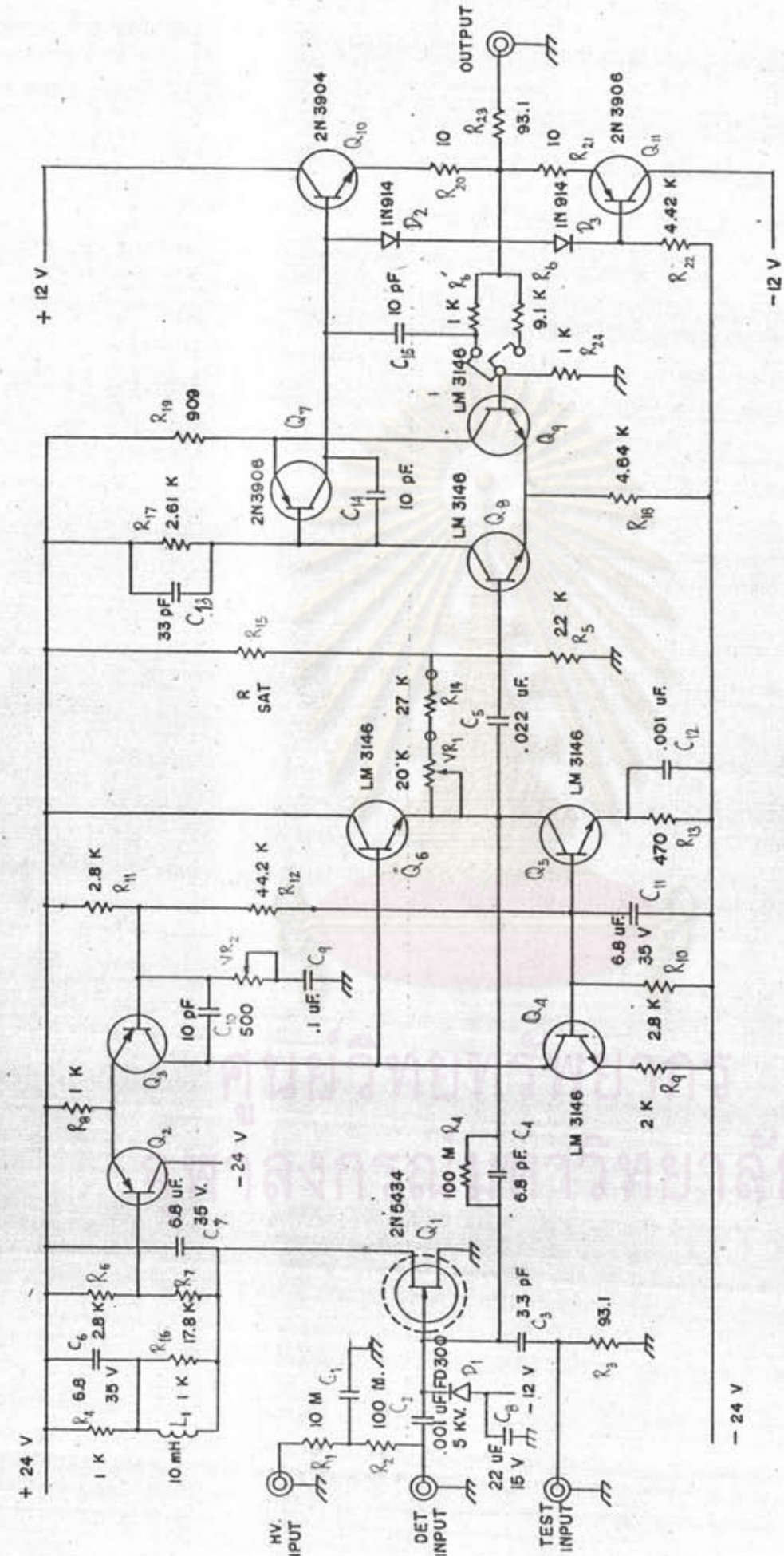

Fig. A.1 Preamplifier circuit.

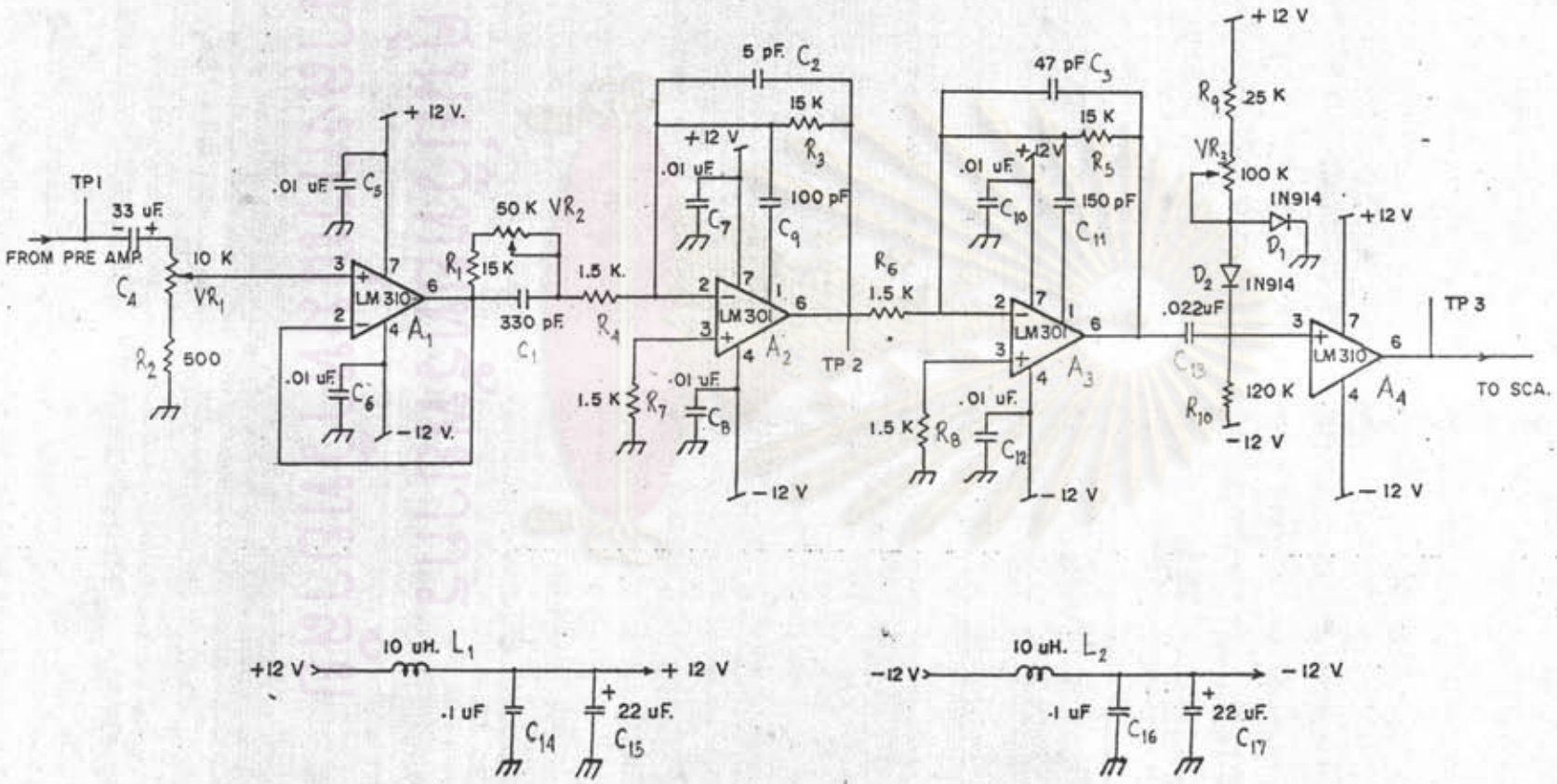

Fig. A.2 Amplifier circuit.

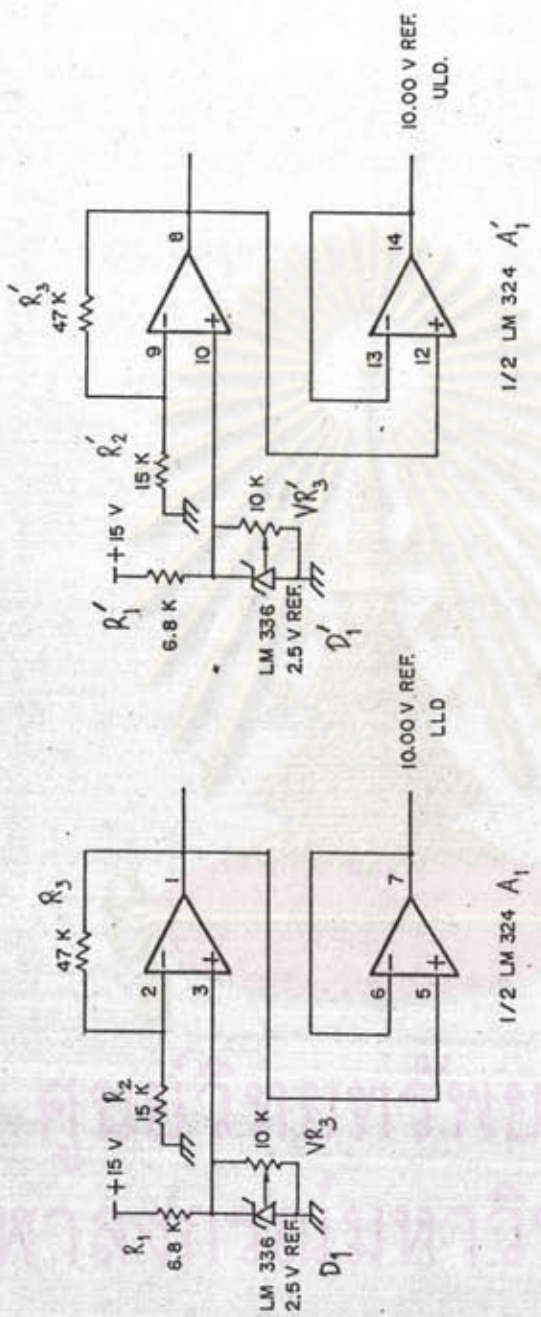

Fig. A.3 Voltage reference circuit.

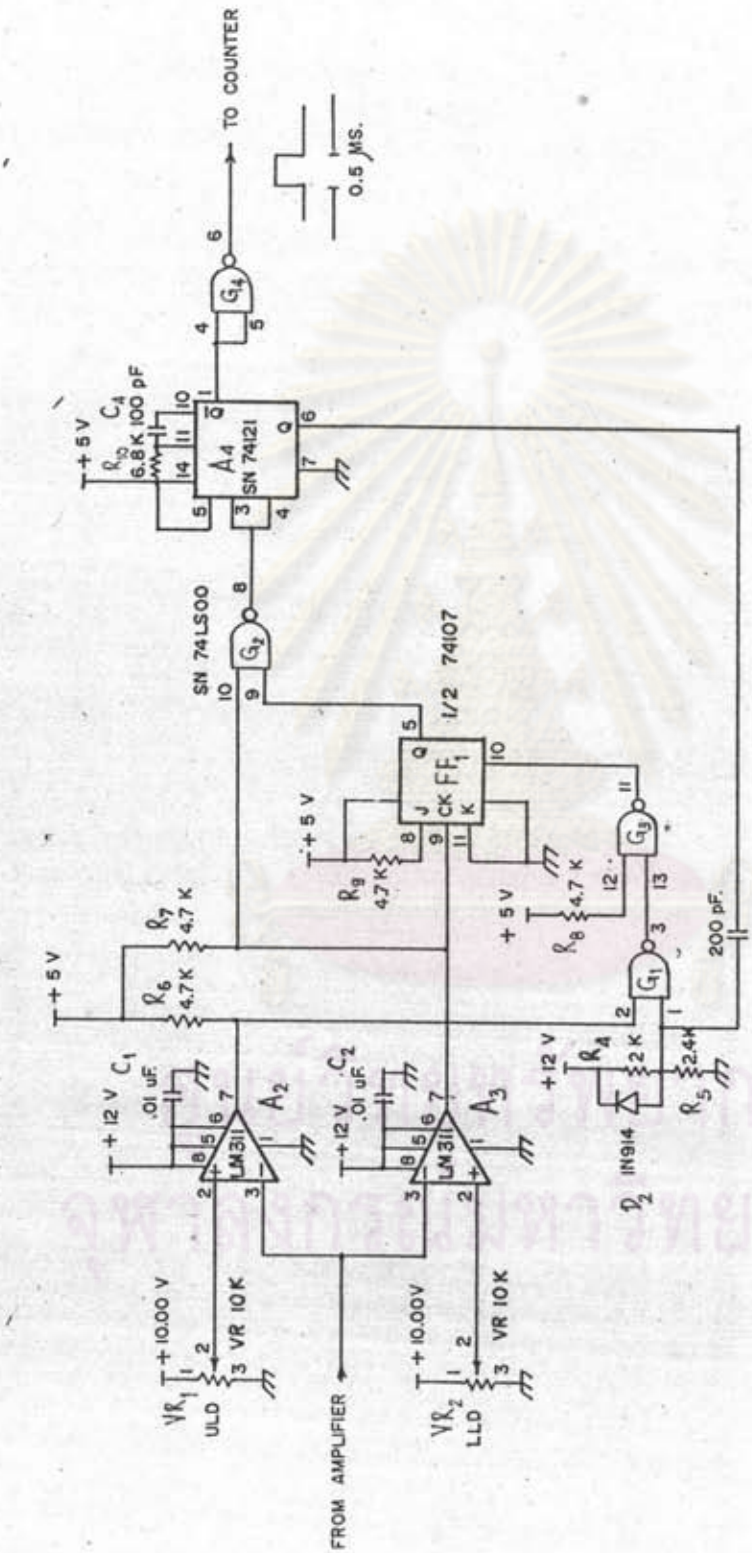

Fig. A.4 Pulse height analyzer circuit.

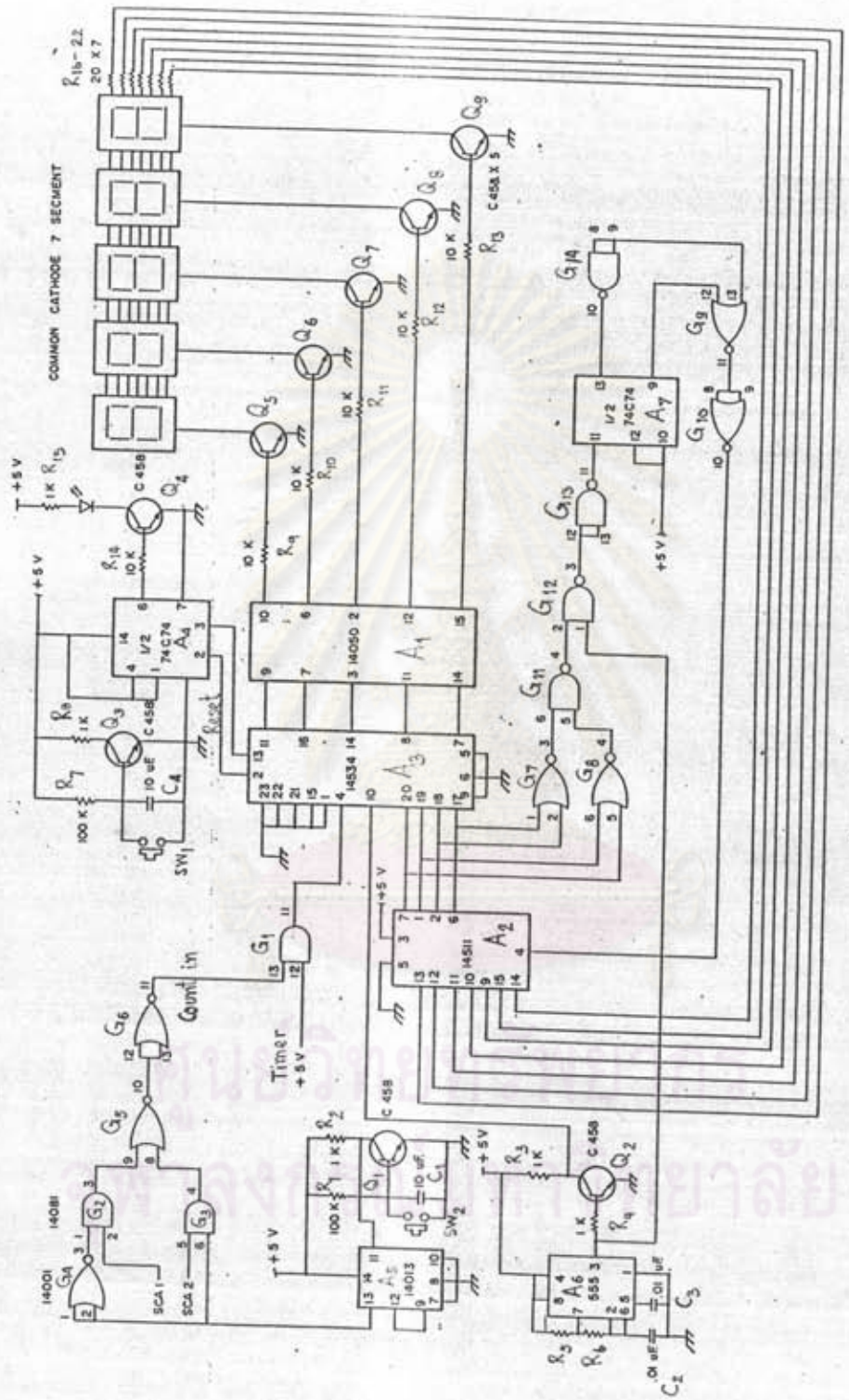

Fig. A.5 Scaler circuit.

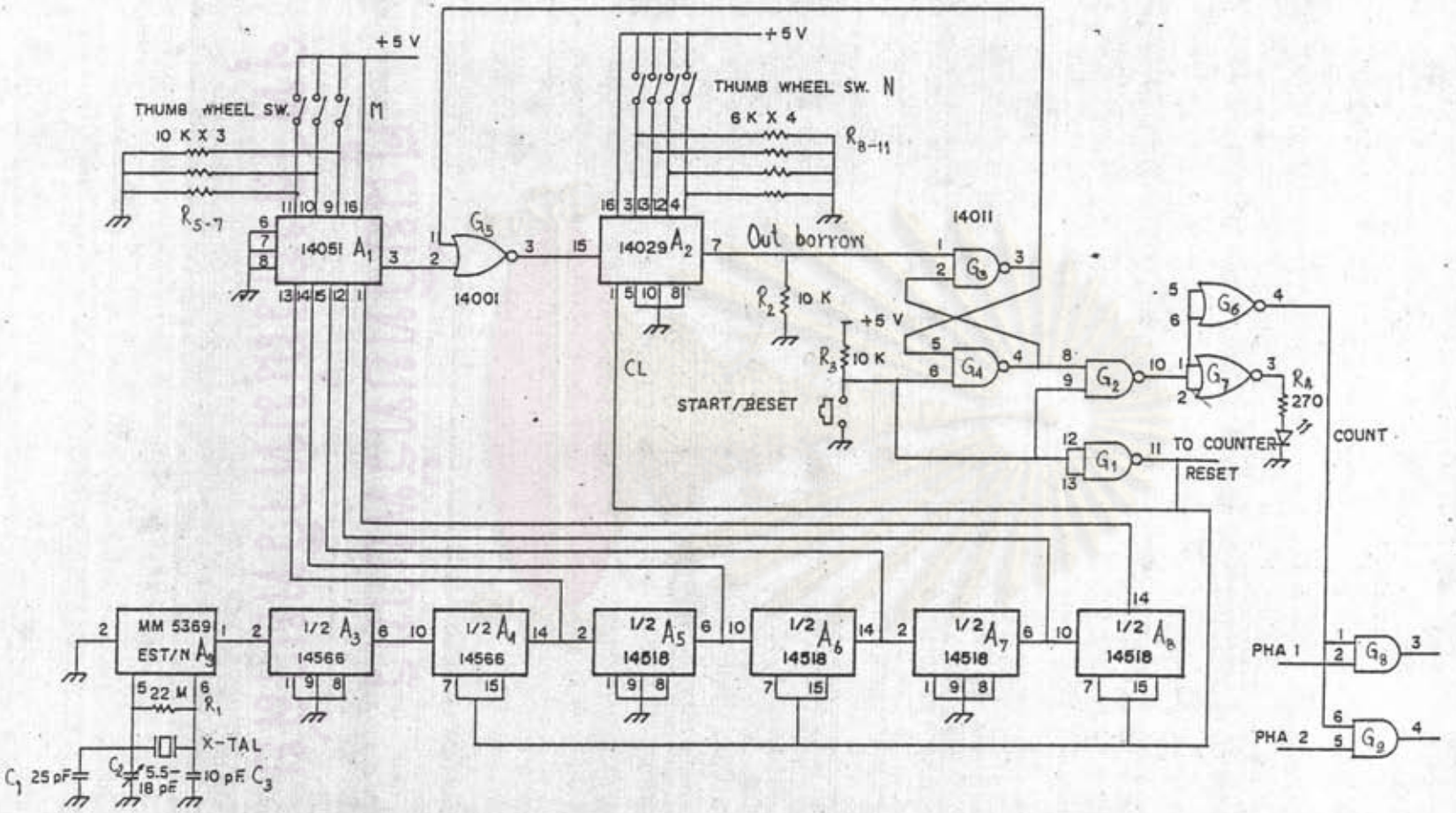

Fig. A.6 Timer circuit.

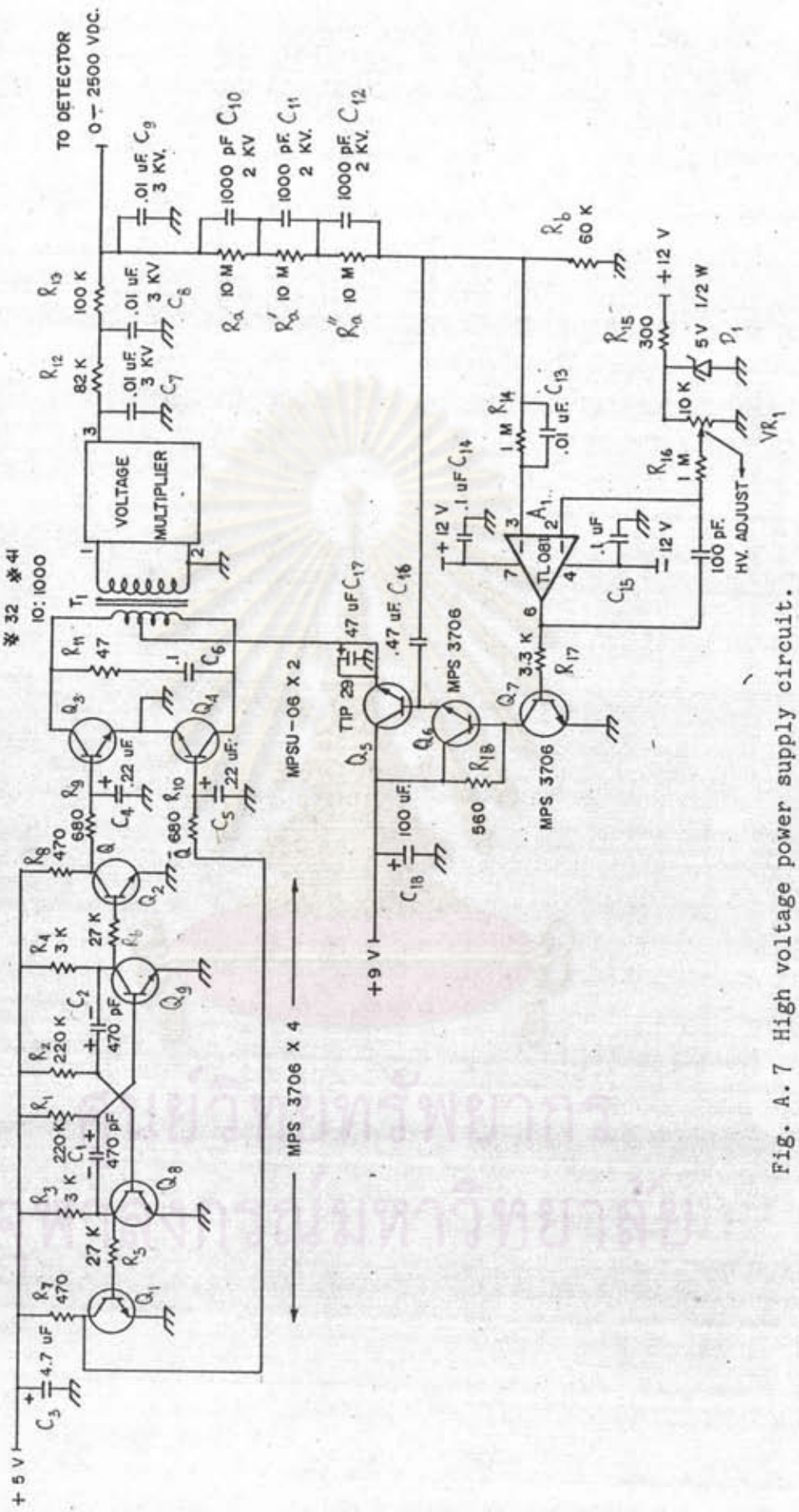

Fig. A.7 High voltage power supply circuit.

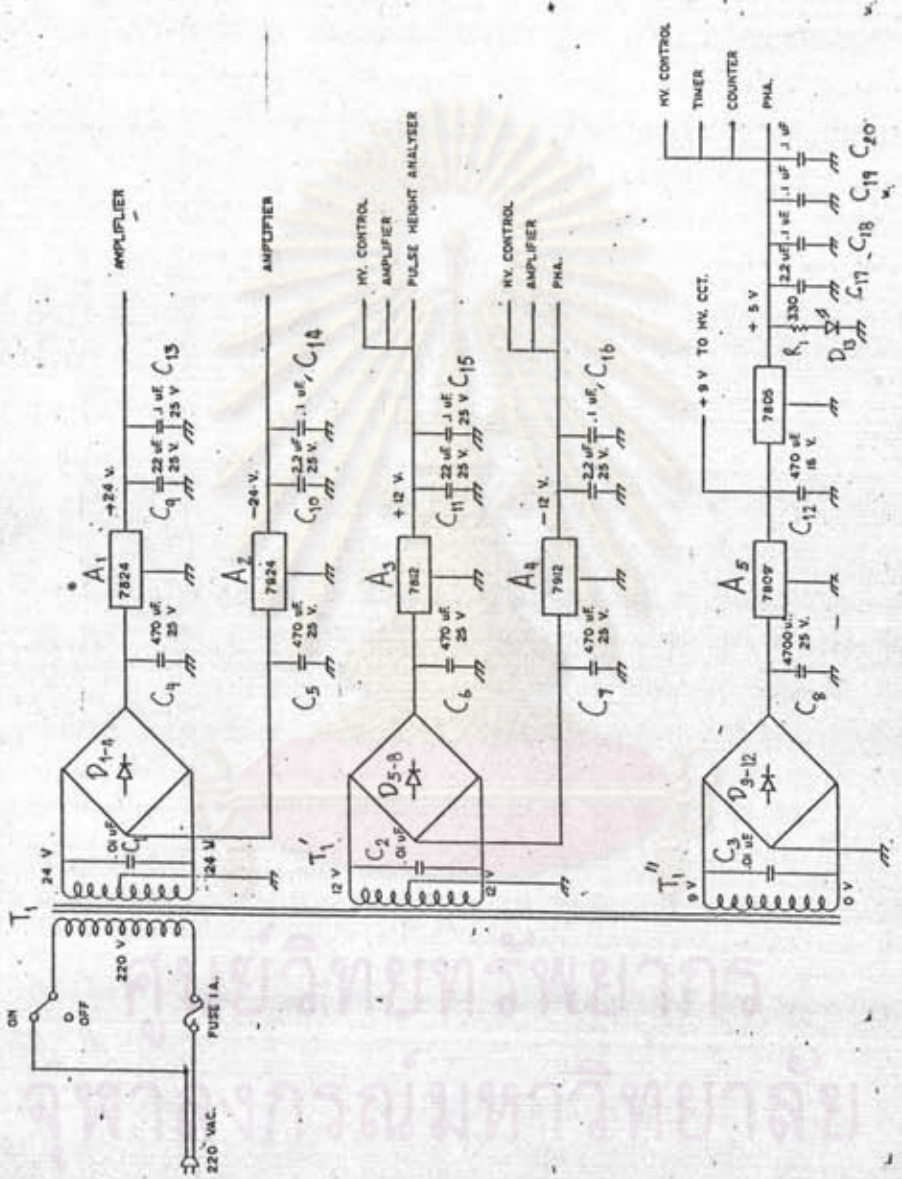

Fig. A.8 Low voltage power supply circuit.

APPENDIX B

COUNT RATES OF X-RAY FLUORESCENCE SPECTRA

(a) From SCA

S K X-ray = 2.308 keV: Source Fe-55 (20 mCi): E = 0.05

LLD	cps	LLD	cps
0.50	75	1.00	154
0.55	80	1.05	137
0.60	95	1.10	85
0.65	113	1.15	81
0.70	218	1.20	88
0.75	326		
0.80	597		
0.85	582		
0.90	315		
0.95	220		

Ar K X-ray = 2.957 keV: Source Fe-55 (20 mCi): E = 0.05

LLD	cps	LLD	cps
0.50	30	1.00	59
0.55	68	1.05	58
0.60	109	1.10	47
0.65	178	1.15	81
0.70	255	1.20	88
0.75	302		
0.80	267		
0.85	228		
0.90	126		
0.95	64		

Fe K X-ray = 6.403 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
1.85	60	2.35	176
1.90	61	2.40	151
1.95	89	2.45	127
2.00	112	2.50	113
2.05	139	2.55	102
2.10	150	2.60	77
2.15	203	2.65	74
2.20	229		
2.25	227		
2.30	214		

Ni K X-ray = 7.477 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
2.15	66	2.65	317
2.20	61	2.70	286
2.25	75	2.75	254
2.30	113	2.80	197
2.35	149	2.85	211
2.40	199	2.90	153
2.45	229	2.95	156
2.50	286	3.00	114
2.55	278	3.05	86
2.60	302	3.10	62

Zn K X-ray = 8.638 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
2.55	43	3.05	247
2.60	57	3.10	224
2.65	71	3.15	193
2.70	81	3.20	175
2.75	104	3.25	147
2.80	160	3.30	133
2.85	165	3.35	109
2.90	235	3.40	99
2.95	238	3.45	91
3.00	254	3.50	78

As K X-ray = 10.543 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps	LLD	cps
3.20	58	3.70	370	4.20	235
3.25	66	3.75	382	4.25	239
3.30	114	3.80	337	4.30	190
3.35	163	3.85	332	4.35	193
3.40	191	3.90	313	4.40	179
3.45	226	3.95	285	4.45	153
3.50	293	4.00	297	4.50	141
3.55	334	4.05	241	4.55	109
3.60	348	4.10	222	4.60	98
3.65	376	4.15	263	4.65	87

Pb L X-rays = 10.549, 12.611, 14.762 keV: Source Cd-109 (20 mCi)

E = 0.05

LLD	cps	LLD	cps	LLD	cps
3.20	58	3.70	370	4.20	235
3.25	66	3.75	382	4.25	239
3.30	114	3.80	337	4.30	190
3.35	163	3.85	332	4.35	193
3.40	191	3.90	313	4.40	179
3.45	226	3.95	285	4.45	153
3.50	293	4.00	297	4.50	141
3.55	334	4.05	241	4.55	109
3.60	348	4.10	222	4.60	98
3.65	376	4.15	263	4.65	87

(b) From two-channel analyzer

S K X-ray = 2.308 keV: Source Fe-55 (20 mCi): E = 0.05

LLD	cps	LLD	cps
0.20	2590	0.70	302
0.25	1666	0.75	216
0.30	654	0.80	218
0.35	819	0.85	210
0.40	998	0.90	201
0.45	1012	0.95	176
0.50	1229	1.00	153
0.55	980	1.05	142
0.60	670	1.10	112
0.65	705		

Ar K X-ray = 2.957 keV: Source Fe-55 (20 mCi): E = 0.05

LLD	cps	LLD	cps
0.20	1998	0.70	378
0.25	1364	0.75	362
0.30	573	0.80	199
0.35	443	0.85	150
0.40	325	0.90	95
0.45	351	0.95	93
0.50	379		
0.55	440		
0.60	463		
0.65	520		

Fe K X-ray = 6.403 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
1.20	99	1.70	294
1.25	115	1.75	277
1.30	215	1.80	228
1.35	297	1.85	182
1.40	394	1.90	153
1.45	508	1.95	167
1.50	541	2.00	167
1.55	570		
1.60	464		
1.65	432		

Ni K X-ray = 7.477 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
1.30	106	1.80	539
1.35	122	1.85	656
1.40	108	1.90	578
1.45	121	1.95	462
1.50	131	2.00	412
1.55	254	2.05	326
1.60	331	2.10	289
1.65	346	2.15	180
1.70	364	2.20	137
1.75	425	2.25	130

Zn K X-ray = 8.638 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps
1.75	170	2.25	546
1.80	215	2.30	509
1.85	278	2.35	432
1.90	311	2.40	369
1.95	356	2.45	320
2.00	389	2.50	297
2.05	425	2.55	245
2.10	489	2.60	187
2.15	593	2.65	165
2.20	572	2.70	155

As K X-ray = 10.543 keV: Source Cd-109 (20 mCi): E = 0.05

LLD	cps	LLD	cps	LLD	cps
1.95	110	2.45	391	2.95	246
2.00	121	2.50	421	3.00	187
2.05	123	2.55	561	3.05	112
2.10	156	2.60	588		
2.15	188	2.65	643		
2.20	280	2.70	546		
2.25	321	2.75	489		
2.30	293	2.80	446		
2.35	418	2.85	387		
2.40	407	2.90	257		

Pb L X-rays = 10.549, 12.611, 14.762 keV: Source Cd-109 (20 mCi)

E = 0.05

LLD	cps	LLD	cps	LLD	cps
2.15	145	2.65	638	3.15	378
2.20	178	2.70	512	3.20	402
2.25	259	2.75	480	3.25	384
2.30	311	2.80	468	3.30	321
2.35	329	2.85	416	3.35	285
2.40	371	2.90	402	3.40	254
2.45	382	2.95	394	3.45	211
2.50	487	3.00	358	3.50	189
2.55	551	3.05	332	3.55	155
2.60	589	3.10	356	3.60	135

BIOGRAPHY

The author was born on July 26th, 1960 in Bangkok. He began studying in Phra Mae Mary School and then Yannawejvithayakom School. He got the Science Diploma of Institute of Analytical Chemistry Training, Affiliated Institute of Chulalongkorn University. In 1976, He received the Bachelor of Science, Chulalongkorn University and went on his study towards the Master degree of Nuclear Technology in the same year. He has been working in the National Center for Genetic Engineering and Biotechnology, Ministry of Science, Technology and Energy since 1978.