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ภาคผนวก

Platinum/Rhodium (about 13%) versus Platinum Thermocouples(PR)
 (JIS C 1602-1974 Based on The International Practical Temperature Scale of 1968)
 EMF in Absolute Millivolts. Temperature in Degrees celsius. Reference Junction at 0°C

TEMP °C	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	TEMP °C
0	0.0000 541	0.6452 754	1.4643 888	2.3939 974	3.3974 1036	4.4564 1086	5.5635 1133	6.7172 1180	7.9180 1227	9.1657 1273	10.458 132	11.792 135	13.158 139	14.549 140	15.952 140	17.353 139	18.736 136	20.081 131	0
10	0.0541 568	0.7206 770	1.5531 898	2.4913 982	3.5010 1041	4.5650 1090	5.6768 1137	6.8352 1184	8.0407 1231	9.2930 1277	10.590 132	11.927 136	13.297 138	14.689 140	16.092 141	17.492 139	18.872 136	20.212 131	10
20	0.1109 592	0.7976 768	1.6492 908	2.5895 988	3.6051 1046	4.6740 1096	5.7905 1142	6.9536 1189	8.1638 1236	9.4207 1282	10.722 132	12.063 136	13.435 139	14.829 140	16.233 140	17.631 139	19.008 136	20.343 130	20
30	0.1701 615	0.8762 800	1.7337 918	2.6883 995	3.7097 1052	4.7836 1100	5.9047 1147	7.0725 1194	8.2874 1241	9.5489 1287	10.854 133	12.199 136	13.574 138	14.969 140	16.373 140	17.770 139	19.144 136	20.473 129	30
40	0.2316 639	0.9562 815	1.8255 926	2.7878 1001	3.8149 1057	4.8936 1105	6.0194 1151	7.1919 1198	8.4115 1245	9.6776 1290	10.987 133	12.335 136	13.712 139	15.109 141	16.513 141	17.909 139	19.280 134	20.692 129	40
50	0.2955 660	1.0377 829	1.9181 936	2.8879 1007	3.9206 1061	5.0041 1109	6.1345 1156	7.3117 1203	8.5360 1250	9.8066 1296	11.120 134	12.471 137	13.851 140	15.250 140	16.654 140	18.048 138	19.414 135	20.731 128	50
60	0.3615 680	1.1206 841	2.0117 943	2.9886 1013	4.0267 1067	5.1150 1115	6.2501 1161	7.4320 1208	8.6610 1255	9.9362 1298	11.254 134	12.608 137	13.991 139	15.390 141	16.794 140	18.186 138	19.549 133	20.859 127	60
70	0.4295 701	1.2047 854	2.1060 952	3.0899 1019	4.1334 1072	5.2265 1118	6.3662 1166	7.5528 1213	8.7865 1260	10.066 131	11.388 134	12.745 138	14.130 140	15.531 140	16.934 140	18.324 138	19.682 134	20.986 -	70
80	0.4996 719	1.2901 866	2.2012 960	3.1918 1025	4.2406 1076	5.3383 1124	6.4828 1170	7.6741 1217	8.9125 1263	10.197 130	11.522 135	12.883 138	14.270 139	15.671 140	17.074 139	18.462 137	19.816 132	-	80
90	0.5715 737	1.3767 876	2.2972 967	3.2943 1031	4.3482 1082	5.4507 1128	6.5998 1174	7.7958 1222	9.0388 1269	10.327 131	11.675 135	13.021 137	14.409 140	15.811 141	17.213 141	18.599 137	19.948 133	-	90
100	0.6452	1.4643	2.3939	3.3974	4.4564	5.5635	6.7172	7.9180	9.1657	10.458	11.792	13.158	14.549	15.952	17.353	18.736	20.081	-	100

ตารางที่ ก-1 แสดงความสัมพันธ์ระหว่างแรงเคลื่อนไฟฟ้ากับอุณหภูมิ
 ของเทอร์โมคัปเปิลชนิด PR

Chromel versus Alumel Thermocouples(CA)
 (JIS C 1602-1974 Based on The International Practical Temperature Scale of 1968)
 EMF in Absolute Millivolts. Temperature in degrees Celsius. Reference Junction at 0°C

TEMP °C	-100	-0	TEMP °C	0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	TEMP °C
- 0	-3.553 299	0.000 392	0	0.000 397	4.095 413	8.137 400	12.207 416	16.395 423	20.640 426	24.902 425	29.128 419	33.277 409	37.325 399	41.269 388	45.108 378	48.828 364	52.398 349	0
- 10	-3.852 286	-0.392 385	10	0.397 401	4.508 411	8.537 401	12.623 416	16.818 423	21.066 427	25.327 424	29.547 418	33.686 409	37.724 398	41.657 388	45.486 377	49.192 363	52.747 346	10
- 20	-4.138 272	-0.777 379	20	0.798 405	4.919 408	8.938 403	13.039 417	17.241 424	21.493 426	25.751 425	29.965 418	34.095 407	38.122 397	42.045 387	45.863 375	49.555 361	53.093 346	20
- 30	-4.410 259	-1.156 371	30	1.203 408	5.327 406	9.341 404	13.456 418	17.664 424	21.919 427	26.176 423	30.383 416	34.502 407	38.519 396	42.432 385	46.238 374	49.916 360	53.449 343	30
- 40	-4.669 243	-1.527 362	40	1.611 411	5.733 404	9.745 406	13.874 418	18.088 425	22.346 426	26.599 423	30.799 415	34.909 405	38.915 395	42.817 385	46.612 373	50.276 357	53.782 343	40
- 50	-4.912 229	-1.889 354	50	2.022 414	6.137 402	10.151 409	14.292 420	18.513 425	22.772 426	27.022 423	31.214 415	35.314 404	39.310 393	43.202 383	46.985 371	50.633 357	54.125 341	50
- 60	-5.141 213	-2.243 343	60	2.436 414	6.539 400	10.560 409	14.712 420	18.938 425	23.198 426	27.445 422	31.629 413	35.718 403	39.703 393	43.585 383	47.356 370	50.990 354	54.466 341	60
- 70	-5.354 196	-2.586 334	70	2.850 416	6.939 399	10.969 412	15.132 420	19.363 425	23.624 426	27.867 421	32.042 413	36.121 403	40.096 392	43.968 381	47.726 396	51.344 353	54.807 -	70
- 80	-5.550 180	-2.920 322	80	3.266 415	7.338 399	11.381 412	15.552 422	19.788 426	24.050 426	28.288 421	32.455 411	36.524 401	40.488 391	44.349 380	48.095 367	51.697 352	-	80
- 90	-5.730 161	-3.242 311	90	3.681 414	7.737 400	11.793 414	15.974 421	20.214 426	24.476 426	28.709 419	32.866 411	36.925 400	40.879 390	44.729 379	48.462 366	52.049 349	-	90
-100	-5.891	3.553	100	4.095	8.137	12.207	16.395	20.640	24.902	29.128	33.277	37.325	41.269	45.108	48.828	52.398	-	100

ตารางที่ ก-2 แสดงความสัมพันธ์ระหว่างแรงเคลื่อนไฟฟ้ากับอุณหภูมิ
 ของเทอร์โมคัปเปิลชนิด CA

Chromel versus Constantan Thermocouples(CRC)
 (JIS C 1602-1974 Based on The International Practical Temperature Scale of 1968)
 EMF in Absolute Millivolts. Temperature in Degrees Celsius. Reference Junction at 0°C

TEMP °C	-100	- 0	TEMP °C	0	100	200	300	400	500	600	700	800	900	TEMP °C
- 0	-5.24 44	0.00 58	0	0.00 59	6.32 68	13.42 74	21.03 78	28.94 80	37.00 81	45.09 81	53.11 80	61.02 79	68.78 77	0
-10	-5.68 43	-0.58 57	10	0.59 60	7.00 68	14.16 75	21.81 79	29.74 81	37.81 81	45.89 81	53.91 79	61.81 78	69.55 76	10
-20	-6.11 41	-1.15 56	20	1.19 61	7.68 70	14.91 75	22.60 78	30.55 80	38.62 81	46.70 80	54.70 80	62.59 78	70.31 77	20
-30	-6.52 39	-1.71 54	30	1.80 62	8.38 70	15.66 76	23.38 79	31.35 81	39.43 81	47.50 81	55.50 79	63.37 78	71.08 76	30
-40	-6.91 37	-2.25 54	40	2.42 63	9.08 71	16.42 76	24.17 79	32.16 80	40.24 81	48.31 80	56.29 79	64.15 77	71.84 75	40
-50	-7.28 35	-2.79 52	50	3.05 63	9.79 71	17.18 76	24.96 79	32.96 81	41.05 80	49.11 80	57.08 79	64.92 78	72.59 76	50
-60	-7.63 33	-3.31 50	60	3.68 65	10.50 72	17.94 77	25.75 80	33.77 80	41.85 81	49.91 80	57.87 79	65.70 77	73.35 75	60
-70	-7.96 31	-3.81 49	70	4.33 65	11.22 73	18.71 77	26.55 80	34.57 81	42.66 81	50.71 80	58.66 79	66.47 78	74.10 76	70
-80	-8.27 29	-4.30 48	80	4.98 67	11.95 73	19.48 78	27.35 79	35.38 81	43.47 81	51.51 80	59.45 79	67.25 77	74.86 75	80
-90	-8.56 26	-4.78 46	90	5.65 67	12.68 74	20.26 77	28.14 80	36.19 81	44.28 81	52.31 80	60.24 78	68.02 76	75.61 75	90
-100	-8.82	-5.24	100	6.32	13.42	21.03	28.94	37.00	45.09	53.11	61.02	68.78	76.36	100

ตารางที่ ก-3 แสดงความสัมพันธ์ระหว่างแรงเคลื่อนไฟฟ้ากับอุณหภูมิ
 ของเทอร์โมคัปเปิลชนิด CRC

Iron versus Constantan Thermocouples(IC)
 (JIS C 1602-1974 Based on The International Practical Temperature Scale of 1968)
 EMF in Absolute Millivolts. Temperature in Degrees Celsius. Reference Junction at 0°C

TEMP °C	-100	- 0	TEMP °C	0	100	200	300	400	500	600	700	800	TEMP °C
- 0	-4.63 41	0.00 50	0	0.00 51	5.27 54	10.78 55	16.33 55	21.85 55	27.39 56	33.10 58	39.13 62	45.50 64	0
-10	-5.04 39	-0.50 50	10	0.51 51	5.81 55	11.33 56	16.88 55	22.40 55	27.95 56	33.68 59	39.75 63	46.14 65	10
-20	-5.43 37	-1.00 48	20	1.02 52	6.36 55	11.89 55	17.43 55	22.95 55	28.51 57	34.27 60	40.38 63	46.79 64	20
-30	-5.80 36	-1.48 48	30	1.54 52	6.91 55	12.44 56	17.98 56	23.50 55	29.08 56	34.87 59	41.01 64	47.43 65	30
-40	-6.16 34	-1.96 47	40	2.06 53	7.46 55	13.00 55	18.54 55	24.05 56	29.64 57	35.46 61	41.65 63	48.08 64	40
-50	-6.50 32	-2.43 46	50	2.59 53	8.01 55	13.55 56	19.09 55	24.61 55	30.21 57	36.07 60	42.28 64	48.72 63	50
-60	-6.82 30	-2.89 45	60	3.12 53	8.56 55	14.11 55	19.64 55	25.16 56	30.78 58	36.67 61	42.92 64	49.35 64	60
-70	-7.12 28	-3.34 45	70	3.65 54	9.11 56	14.66 56	20.19 55	25.72 55	31.36 57	37.28 61	43.56 65	49.99 63	70
-80	-7.40 26	-3.79 43	80	4.19 54	9.67 55	15.22 55	20.74 56	26.27 56	31.93 58	37.89 62	44.21 64	50.62 63	80
-90	-7.66 23	-4.22 41	90	4.73 54	10.22 56	15.77 56	21.30 55	26.83 56	32.51 59	38.51 62	44.85 65	51.25 63	90
-100	-7.89	-4.63	100	5.27	10.78	16.33	21.85	27.39	33.10	39.13	45.50	51.88	100

ตารางที่ ก-4 แสดงความสัมพันธ์ระหว่างแรงเคลื่อนไฟฟ้ากับอุณหภูมิ
 ของเทอร์โมคัปเปิลชนิด IC

Copper versus Constantan Thermocouples(CC)
 (JIS C 1602-1974 Based on The International Practical Temperature Scale of 1968)
 EMF in Absolute Millivolts. Temperature in Degrees Celsius. Reference Junctions at 0°C

TEMP °C	-100	- 0	TEMP °C	0	100	200	300	TEMP °C
- 0	-3.378 278	0.000 383	0	0.000 391	4.277 472	9.286 534	14.860 583	0
-10	-3.656 267	-0.383 374	10	0.391 398	4.749 478	9.820 540	15.443 587	10
-20	-3.923 254	-0.757 364	20	0.789 407	5.227 485	10.360 545	16.030 591	20
-30	-4.177 242	-1.121 354	30	1.196 415	5.712 492	10.905 551	16.621 596	30
-40	-4.419 229	-1.475 344	40	1.611 424	6.204 498	11.456 555	17.217 599	40
-50	-4.648 217	-1.819 333	50	2.035 432	6.702 505	12.011 561	17.816 604	50
-60	-4.865 204	-2.152 323	60	2.467 441	7.207 511	12.572 565	18.420 607	60
-70	-5.069 192	-2.475 313	70	2.908 449	7.718 517	13.137 570	19.027 611	70
-80	-5.261 178	-2.788 301	80	3.357 456	8.235 522	13.707 574	19.638 614	80
-90	-5.439 164	-3.089 289	90	3.813 464	8.757 529	14.281 579	20.252 617	90
-100	-5.603	-3.378	100	4.277	9.286	14.860	20.869	100

ตารางที่ ก-5 แสดงความสัมพันธ์ระหว่างแรงเคลื่อนไฟฟ้ากับอุณหภูมิ
 ของเทอร์โมคัปเปิลชนิด CC

Platinum Resistance Bulb (Pt)
 (JIS C 1604-1974 Based on The International Practical Temperature Scale of 1968)
 Celsius Temperature versus Absolute Ohms. 100-Ohm Bulb at 0°C

TEMP °C	-100	- 0	TEMP °C	0	100	200	300	400	500	600	TEMP °C
- 0	59.57 4.13	100.00 3.98	0	100.00 3.97	139.16 3.85	177.13 3.73	213.93 3.61	249.56 3.50	284.02 3.38	317.28 3.26	0
-10	55.44 4.15	96.02 4.00	10	103.97 3.96	143.01 3.84	180.86 3.72	217.54 3.61	253.06 3.49	287.40 3.37	320.54 3.24	10
-20	51.29 4.18	92.02 4.01	20	107.93 3.95	146.85 3.82	184.58 3.71	221.15 3.59	256.55 3.47	290.77 3.35	323.78 3.24	20
-30	47.11 4.20	88.01 4.02	30	111.88 3.93	150.67 3.82	188.29 3.70	224.74 3.58	260.02 3.47	294.12 3.35	327.02 -	30
-40	42.91 4.23	83.99 4.03	40	115.81 3.92	154.49 3.80	191.99 3.68	228.32 3.57	263.49 3.45	297.47 3.33	-	40
-50	38.68 4.26	79.96 4.05	50	119.73 3.91	158.29 3.79	195.67 3.68	231.89 3.56	266.94 3.44	300.80 3.32	-	50
-60	34.42 4.30	75.91 4.06	60	123.64 3.90	162.08 3.78	199.35 3.66	235.45 3.54	270.38 3.42	304.12 3.31	-	60
-70	30.12 4.32	71.85 4.08	70	127.54 3.88	165.86 3.77	203.01 3.65	238.99 3.54	273.80 3.42	307.43 3.29	-	70
-80	25.80 4.34	67.77 4.09	80	131.42 3.88	169.63 3.75	206.66 3.64	242.53 3.52	277.22 3.41	310.72 3.29	-	80
-90	21.46 4.32	63.68 4.11	90	135.30 3.86	173.38 3.75	210.30 3.63	246.05 3.51	280.63 3.39	314.01 3.27	-	90
-100	17.14	59.57	100	139.16	177.13	213.93	249.56	284.02	317.28	-	100

ตารางที่ ก-6 แสดงความสัมพันธ์ระหว่างความต้านทานกับอุณหภูมิ
 ของกระเปาะความต้านทานชนิด Pt-100

Platinum Resistance Bulb (Pt)
(JIS C 1604-1974 Based on The International Practical Temperature Scale of 1968)
Celsius Temperature versus Absolute Ohms. 50-Ohm Bulb at 0 C

TEMP °C	-100	- 0	TEMP °C	0	100	200	300	400	500	600	TEMP °C
- 0	29.785 2.065	50.000 1.990	0	50.000 1.985	69.580 1.925	88.565 1.865	106.965 1.805	124.780 1.750	142.010 1.690	158.640 1.630	0
-10	27.720 2.075	48.010 2.000	10	51.985 1.980	71.505 1.920	90.430 1.860	108.770 1.805	126.530 1.745	143.700 1.685	160.270 1.620	10
-20	25.645 2.090	46.010 2.005	20	53.965 1.975	73.425 1.910	92.290 1.855	110.575 1.795	128.275 1.735	145.385 1.675	161.890 1.620	20
-30	23.555 2.100	44.005 2.010	30	55.940 1.965	75.335 1.910	94.145 1.850	112.370 1.790	130.010 1.735	147.060 1.675	163.510 -	30
-40	21.455 2.115	41.995 2.015	40	57.905 1.960	77.245 1.900	95.995 1.840	114.160 1.785	131.745 1.725	148.735 1.665	-	40
-50	19.340 2.130	39.980 2.025	50	59.865 1.955	79.145 1.895	97.835 1.840	115.945 1.780	133.470 1.720	150.400 1.660	-	50
-60	17.210 2.150	37.955 2.030	60	61.820 1.950	81.040 1.890	99.675 1.830	117.725 1.770	135.190 1.710	152.060 1.655	-	60
-70	15.060 2.160	35.925 2.040	70	63.770 1.940	82.930 1.885	101.505 1.825	119.495 1.770	136.900 1.710	153.715 1.645	-	70
-80	12.900 2.170	33.885 2.045	80	65.710 1.940	84.815 1.875	103.330 1.820	121.265 1.760	138.610 1.705	155.360 1.645	-	80
-90	10.730 2.160	31.840 2.055	90	67.650 1.930	86.690 1.875	105.150 1.815	123.025 1.755	140.315 1.695	157.005 1.635	-	90
-100	8.570	29.785	100	69.580	88.565	106.965	124.780	142.010	158.640	-	100

ตารางที่ ก-7 แสดงความสัมพันธ์ระหว่างความต้านทานกับอุณหภูมิ
ของกระเปาะความต้านทานชนิด Pt-50

ภาคผนวก ข. ข้อมูลการทดสอบระบบเก็บข้อมูลแบบอะนาลอก

ตารางที่ ข-1 แสดงผลการทดสอบการวัดแรงเคลื่อนไฟฟ้า

สัญญาณเข้าจาก แหล่งกำเนิดสัญญาณมาตรฐาน mV	ค่าแรงดันไฟฟ้าที่อ่านได้ จากเครื่องวัดแรงดัน mV	ค่าแรงดันไฟฟ้าที่อ่านได้จาก ระบบเก็บข้อมูลแบบอะนาลอก mV
10.000	10.001	-
9.500	9.501	19.00
9.000	9.001	18.00
8.500	8.501	17.00
8.000	8.000	16.00
7.500	7.501	15.00
7.000	7.000	14.00
6.500	6.501	13.00
6.000	6.000	12.00
5.500	5.501	11.00
5.000	5.001	10.00
4.500	4.502	9.00
4.000	4.001	8.00
3.500	3.502	7.00
3.000	3.002	6.00
2.500	2.502	5.00
2.000	2.001	3.99
1.500	1.502	3.00
1.000	1.001	1.99
0.500	0.502	1.00
0.000	0.001	0.00
-0.500	-0.501	-1.00
-1.000	-1.002	-2.00
-1.500	-1.501	-3.00
-2.000	-2.001	-4.00
-2.500	-2.500	-5.00
-3.000	-3.001	-6.00
-3.500	-3.500	-7.00
-4.000	-4.000	-8.00
-4.500	-4.499	-8.99
-5.000	-5.000	-9.99
-5.500	-5.499	-10.99
-6.000	-6.000	-11.99
-6.500	-6.498	-12.99
-7.000	-6.999	-13.99
-7.500	-7.498	-14.99
-8.000	-7.999	-15.99
-8.500	-8.498	-16.99
-9.000	-8.999	-17.99
-9.500	-9.498	-18.99
-10.000	-9.999	-

ตารางที่ ข-2 แสดงผลการทดสอบการวัดอุณหภูมิโดยใช้
แหล่งกำเนิดสัญญาณมาตรฐาน

สัญญาณเข้าจาก แหล่งกำเนิดสัญญาณ มาตรฐาน mV	ค่าอุณหภูมิ ที่อ่านได้จาก ระบบเก็บข้อมูลแบบอะนาล็อก °C	สัญญาณเข้าจาก แหล่งกำเนิดสัญญาณ มาตรฐาน mV	ค่าอุณหภูมิ ที่อ่านได้จาก ระบบเก็บข้อมูลแบบอะนาล็อก °C
0.000	0.0	-0.000	- 0.0
0.397	10.0	-0.392	- 9.9
0.798	20.0	-0.777	- 19.9
1.203	30.0	-1.156	- 29.9
1.611	40.0	-1.527	- 39.9
2.022	50.0	-1.889	- 49.9
2.436	60.0	-2.243	- 60.0
2.850	70.0	-2.586	- 69.9
3.266	80.0	-2.920	- 79.9
3.681	90.0	-3.242	- 90.0
4.095	100.1	-3.553	- 9.9
4.508	110.0	-3.852	-110.0
4.919	120.1	-4.138	-119.9
5.327	130.0	-4.410	-130.0
5.733	140.1	-4.669	-140.0
6.137	150.2	-4.912	-150.0
6.539	160.1	-5.141	-160.0
6.939	170.1	-5.354	-170.0
7.338	180.1	-5.550	-179.9
7.737	190.2	-5.730	-189.9
8.137	-	-5.891	-199.9

ตารางที่ ข-3 แสดงผลการทดสอบการวัดแรงดันไฟฟ้าที่เกิดจาก
วงจรบริคจ์ไม่สมดุลย์

สัญญาณเข้าจาก ค่าความต้านทานมาตรฐาน ปรับค่าได้	ค่าแรงดันไฟฟ้าที่ได้ จากการคำนวณ mV	ค่าแรงดันไฟฟ้าที่อ่านจาก ระบบเก็บข้อมูลแบบอะนาลอก mV
17.14	-21.658	-
21.46	-20.524	-
25.80	-19.386	-19.38
30.12	-18.253	-18.25
34.42	-17.126	-17.13
38.68	-16.010	-16.02
42.91	-14.903	-15.91
47.11	-13.804	-13.81
51.29	-12.710	-12.72
55.44	-11.625	-11.64
59.57	-10.545	-10.56
63.68	- 9.471	- 9.49
67.77	- 8.403	- 8.42
71.85	- 7.338	- 7.35
75.91	- 6.278	- 6.29
79.96	- 5.222	- 5.23
83.99	- 4.171	- 4.18
88.01	- 3.123	- 3.13
92.02	- 2.078	- 2.09
96.02	- 1.036	- 1.04
100.00	0.000	0.00
103.97	1.033	1.03
107.93	2.063	2.07
111.88	3.091	3.08
115.81	4.112	4.13
119.73	5.131	5.15
123.64	6.146	6.16
127.54	7.159	7.17
131.42	8.166	8.18
135.30	9.172	9.19
139.16	10.173	10.19
143.01	11.172	11.19
146.85	12.167	12.18
150.67	13.156	13.17
154.49	14.145	14.16
158.29	15.129	15.14
162.08	16.110	16.12
165.86	17.087	17.09
169.63	18.062	18.06
173.38	19.031	19.03
177.13	20.000	-

ตารางที่ ข-4 แสดงผลการทดสอบการวัดอุณหภูมิโดยใช้
 ตัวความต้านทานมาตรฐานปรับค่าได้

สัญญาณเข้าจาก ตัวความต้านทานมาตรฐาน ปรับค่าได้ Ω	ค่าอุณหภูมิ ได้จากระบบเก็บ ข้อมูลแบบอะนาล็อก $^{\circ}\text{C}$	สัญญาณเข้าจาก ตัวความต้านทานมาตรฐาน ปรับค่าได้ Ω	ค่าอุณหภูมิ ได้จากระบบเก็บ ข้อมูลแบบอะนาล็อก $^{\circ}\text{C}$
103.97	10.0	96.02	- 10.0
107.93	20.0	92.02	- 20.0
111.88	30.0	88.01	- 30.1
115.81	40.1	83.99	- 40.1
119.73	50.1	79.96	- 50.2
123.64	60.2	75.91	- 60.2
127.54	70.2	71.85	- 70.2
131.42	80.2	67.77	- 80.2
135.30	90.2	63.68	- 90.2
139.16	100.2	59.57	-100.2
143.01	110.2	55.44	-110.2
146.85	120.1	51.29	-120.2
150.67	130.1	47.11	-130.1
154.49	140.0	42.91	-140.1
158.29	150.0	38.68	-150.1
162.08	160.0	34.42	-160.1
165.86	170.0	30.12	-170.1
169.63	179.9	25.80	-180.0
173.38	189.9	21.46	-190.0
177.13	-	17.14	-



ตารางที่ ข-5 แสดงผลการทดสอบการวัดอุณหภูมิโดยใช้
เทอร์โมคัปเปิลชนิด CA และกระเปาะความต้านทานชนิด pt-100

ค่าอุณหภูมิที่อ่าน จากเทอร์โมมิเตอร์ ที่ OII, BATH C	ค่าอุณหภูมิที่อ่าน จากเทอร์โมมิเตอร์ ที่จุดอ้างอิง C	ค่าอุณหภูมิที่อ่านจาก ระบบเก็บข้อมูลแบบ อะนาลอกที่จุดอ้างอิง C	ค่าอุณหภูมิที่วัดด้วย เทอร์โมคัปเปิล ชนิด CA C	ค่าอุณหภูมิที่วัดด้วย กระเปาะความต้านทาน ชนิด pt-100 C
60	26.0	26.0	60.1	60.1
80	26.0	26.0	81.0	80.2
100	26.0	26.0	100.7	100.3
120	25.9	25.9	121.0	120.0
140	25.9	25.9	141.2	139.9
160	25.9	25.9	161.3	160.1
180	26.1	26.1	181.3	180.2

ภาคผนวก ค. รายละเอียดและคุณสมบัติของไอซีต่าง ๆ

**National
Semiconductor**

Instrumentation Amplifiers

LM121/LM221/LM321, LM121A/LM221A/LM321A Precision Preamplifiers

General Description

The LM121 series are precision preamplifiers designed to operate with general purpose operational amplifiers to drastically decrease dc errors. Drift, bias current, common mode and supply rejection are more than a factor of 50 better than standard op amps alone. Further, the added dc gain of the LM121 decreases the closed loop gain error.

The LM121 series operates with supply voltages from $\pm 3V$ to $\pm 20V$ and has sufficient supply rejection to operate from unregulated supplies. The operating current is programmable from $5\mu A$ to $200\mu A$ so bias current, offset current, gain and noise can be optimized for the particular application while still realizing very low drift. Super-gain transistors are used for the input stage so input error currents are lower than conventional amplifiers at the same operating current. Further, the initial offset voltage is easily nulled to zero.

Features

- Guaranteed drift of LM121A series - $0.2\mu V/^{\circ}C$
- Guaranteed drift of LM121 series - $1\mu V/^{\circ}C$

- Offset voltage less than 0.4 mV
- Bias current less than 10 nA at $10\mu A$ operating current
- CMRR 126 dB minimum
- 120 dB supply rejection
- Easily nulled offset voltage

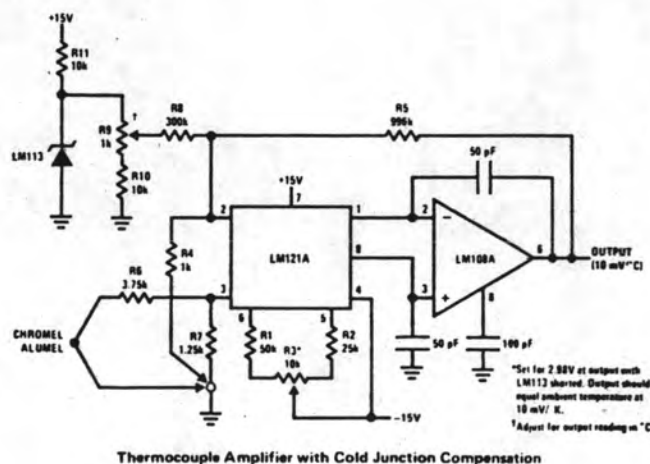
The extremely low drift of the LM121 will improve accuracy on almost any precision dc circuit. For example, instrumentation amplifier, strain gauge amplifiers and thermocouple amplifiers now using chopper amplifiers can be made with the LM121. The full differential input and high common-mode rejection are another advantage over choppers. For applications where low bias current is more important than drift, the operating current can be reduced to low values. High operating currents can be used for low voltage noise with low source resistance. The programmable operating current of the LM121 allows tailoring the input characteristics to match those of specialized op amps.

The LM121 is specified over a $-55^{\circ}C$ to $+125^{\circ}C$ temperature range, the LM221 over a $-25^{\circ}C$ to $+85^{\circ}C$ range and the LM321 over a $0^{\circ}C$ to $+70^{\circ}C$ temperature range.

LM121/LM221/LM321,
LM121A/LM221A/LM321A

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Typical Applications



LM121/LM221/LM321,
LM121A/LM221A/LM321A

Absolute Maximum Ratings

Supply Voltage	±20V
Power Dissipation (Note 1)	500 mW
Differential Input Voltage (Notes 2 and 3)	±15V
Input Voltage (Note 3)	±15V
Operating Temperature Range	
LM121	-55°C to +125°C
LM221	-25°C to +85°C
LM321	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics (Note 4) LM121, LM221, LM321

PARAMETER	CONDITIONS	LM121, LM221			LM321			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	$T_A = 25^\circ\text{C}$, $6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$			0.7			1.5	mV
Input Offset Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$			1			2	nA
				10			20	nA
Input Bias Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$			10			18	nA
				100			180	nA
Input Resistance	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$	4			2			MΩ
		0.4			0.2			MΩ
Supply Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$			1.5			2.2	mA
Input Offset Voltage	$6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$			1.0			2.5	mV
Input Bias Current	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$			30			28	nA
				300			280	nA
Input Offset Current	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$			3			4	nA
				30			40	nA
Input Offset Current Drift	$R_{\text{SET}} = 70\text{k}$		3		3			pA/°C
Average Temperature Coefficient of Input Offset Voltage	$R_S \leq 200\Omega$, $6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$ Offset Voltage Nulled			1			1	$\mu\text{V}/^\circ\text{C}$
Long Term Stability			5		5			$\mu\text{V}/\text{yr}$
Supply Current				2.5			3.5	mA
Input Voltage Range	$V_S = \pm 15\text{V}$, (Note 5) $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$	±13			±13			V
		+7, -13			+7, -13			V
Common-Mode Rejection Ratio	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$	120			114			dB
		114			114			dB
Supply Voltage Rejection Ratio	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$	120			114			dB
		114			114			dB
Voltage Gain	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$, $R_L > 3\text{M}\Omega$			16			12	V/V
Noise	$R_{\text{SET}} = 70\text{k}$, $R_{\text{SOURCE}} = 0$		8		8			$\text{nV}/\sqrt{\text{Hz}}$

Note 1: The maximum junction temperature of the LM121 is 150°C, while that of the LM221 is 100°C. The maximum junction temperature of the LM321 is 85°C. For operating at elevated temperature, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/8 inch thick epoxy glass board with ten, 0.03 inch wide, 2 ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W junction to ambient.

Note 2: The inputs are shunted with back-to-back diodes in series with a 500Ω resistor for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs.

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 4: These specifications apply for $\pm 5 \leq V_S \leq \pm 20\text{V}$ and $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, unless otherwise specified. With the LM221, however, all temperature specifications are limited to $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$, and for the LM321 the specifications apply over a 0°C to +70°C temperature range.

Note 5: External precision resistor - 0.1% - can be placed from pins 1 and 8 to 7 to increase positive common-mode range.

Absolute Maximum Ratings

Supply Voltage	±20V
Power Dissipation (Note 1)	500 mW
Differential Input Voltage (Notes 2 and 3)	±15V
Input Voltage (Note 3)	±15V
Operating Temperature Range	
LM121A	-55°C to +125°C
LM221A	-25°C to +85°C
LM321A	0°C to +70°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Electrical Characteristics (Note 4) LM121A, LM221A, LM321A

PARAMETER	CONDITIONS	LM121A, LM221A			LM321A			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	$T_A = 25^\circ\text{C}$, $6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$		0.2	0.4		0.2	0.4	mV
Input Offset Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		0.3	0.5		0.3	0.5	nA
				5			5	nA
Input Bias Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		5	10		5	15	nA
			50	100		50	150	nA
Input Resistance	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		4	8		2	8	MΩ
			0.4			0.2		MΩ
Supply Current	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$		0.8	1.5		0.8	2.2	mA
Input Offset Voltage	$6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$		0.5	0.65		0.5	0.65	mV
Input Bias Current	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		15	30		15	25	nA
			150	300		150	250	nA
Input Offset Current	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		0.5	1		0.5	1	nA
			5	10		5	10	nA
Input Offset Current Drift	$R_{\text{SET}} = 70\text{k}$		3			3		pA/°C
Average Temperature Coefficient of Input Offset Voltage	$R_S \leq 200\Omega$, $6.4\text{k} \leq R_{\text{SET}} \leq 70\text{k}$ Offset Voltage Nulled		0.07	0.2		0.07	0.2	μV/°C
Long Term Stability			3			3		μV/yr
Supply Current			1	2.5		1	3.5	mA
Input Voltage Range	$V_S = \pm 15\text{V}$, (Note 5) $R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		±13			±13		V
			+7, -13			+7, -13		V
Common-Mode Rejection Ratio	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		126	140		126	140	dB
			120	130		120	130	dB
Supply Voltage Rejection Ratio	$R_{\text{SET}} = 70\text{k}$ $R_{\text{SET}} = 6.4\text{k}$		120	126		118	126	dB
			114	120		114	120	dB
Voltage Gain	$T_A = 25^\circ\text{C}$, $R_{\text{SET}} = 70\text{k}$, $R_L > 3\text{M}\Omega$		16	20		12	20	V/V
Noise	$R_{\text{SET}} = 70\text{k}$, $R_{\text{SOURCE}} = 0$		8			8		nV/√Hz

Note 1: The maximum junction temperature of the LM121A is 150°C, while that of the LM221A is 100°C. The maximum junction temperature of the LM321A is 85°C. For operating at elevated temperature, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/8 inch thick epoxy glass board with ten, 0.03 inch wide, 2 ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W junction to ambient.

Note 2: The inputs are shunted with back-to-back diodes in series with a 500Ω resistor for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs.

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 4: These specifications apply for $\pm 5 \leq V_S \leq \pm 20\text{V}$ and $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, unless otherwise specified. With the LM221A, however, all temperature specifications are limited to $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$, and for the LM321A the specifications apply over a 0°C to $+70^\circ\text{C}$ temperature range.

Note 5: External precision resistor - 0.1% - can be placed from pins 1 and 8 to 7 to increase positive common-mode range.

LM121/LM221/LM321,
LM121A/LM221A/LM321A

Frequency Compensation

UNIVERSAL COMPENSATION

The additional gain of the LM121 preamplifier when used with an operational amplifier usually necessitates additional frequency compensation. When the closed loop gain of the op amp with the LM121 is less than the gain of the LM121 alone, more compensation is needed. The worst case situation is when there is 100% feedback—such as a voltage follower or integrator—and the gain of the LM121 is high. When high closed loop gains are used—for example $A_V = 1000$ —and only an addition gain of 200 is inserted by the LM121, the frequency compensation of the op amp will usually suffice.

The frequency compensation shown here is designed to operate with any unity-gain stable op amp. Figure 1 shows the basic configuration of frequency stabilizing network. In operation the output of the LM121 is rendered single ended by a $0.01\mu\text{F}$ bypass capacitor to ground. Overall frequency compensation then is achieved by an integrating capacitor around the op amp.

$$\text{Bandwidth at unity-gain} \cong \frac{12}{2\pi R_{\text{SET}} C}$$

$$\text{for 0.5 MHz bandwidth } C = \frac{4}{10^6 R_{\text{SET}}}$$

For use with higher frequency op amps such as the LM118 the bandwidth may be increased to about 2 MHz.

If the closed loop gain is greater than unity, "C" may be decreased to:

$$C = \frac{4}{10^6 A_{\text{CL}} R_{\text{SET}}}$$

Typical Applications

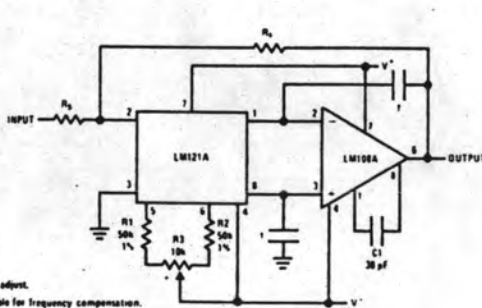


FIGURE 1. Low Drift Op Amp Using the LM121A as a Preamp

ALTERNATE COMPENSATION

The two compensation capacitors can be made equal for improved power supply rejection. In this case the formula for the compensation capacitor is:

$$C = \frac{8}{10^6 A_{\text{CL}} R_{\text{SET}}}$$

Table I shows typical values for the two compensating capacitors for various gains and operating currents.

TABLE I

CLOSED LOOP GAIN	CURRENT SET RESISTOR				
	120 kΩ	60 kΩ	30 kΩ	12 kΩ	6 kΩ
$A_V = 1$	68	130	270	680	1300
$A_V = 5$	15	27	56	130	270
$A_V = 10$	10	15	27	68	130
$A_V = 50$	1	3	5	15	27
$A_V = 100$	-	1	3	5	10
$A_V = 500$	-	-	1	1	3
$A_V = 1000$	-	-	-	-	-

This table applies for the LM108, LM101A, LM741, LM118. Capacitance is in pF.

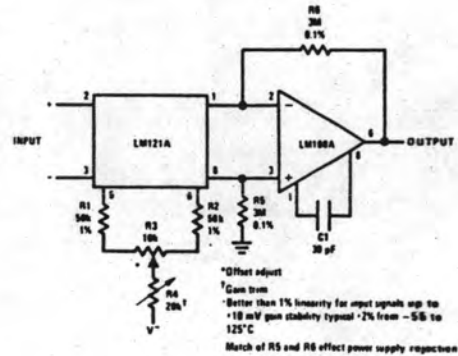
DESIGN EQUATIONS FOR THE LM121 SERIES

$$\text{Gain } A_V \approx \frac{1.2 \times 10^6}{R_{\text{SET}}}$$

Null Pot Value should be 10% of R_{SET}

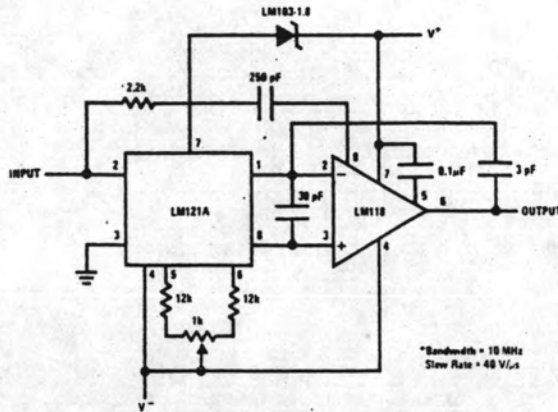
$$\text{Operating Current} \approx \frac{2 \times 0.65V}{R_{\text{SET}}}$$

$$\text{Positive Common-Mode Limit} \approx V^+ - \left[0.6 - \frac{0.65V \times 50k}{R_{\text{SET}}} \right]$$

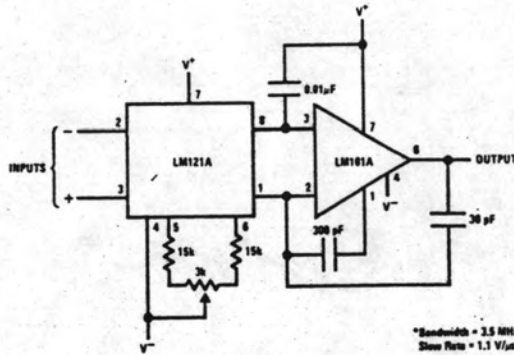


Gain of 1000 Instrumentation Amplifier†

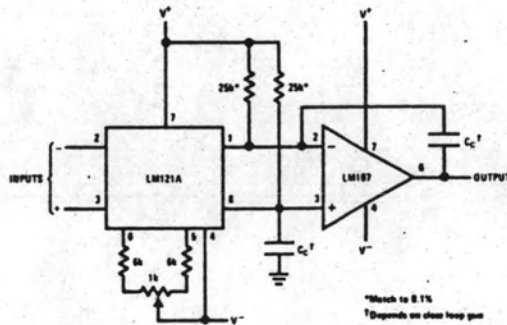
Typical Applications (Continued)



High Speed* Inverting Amplifier with Low Drift



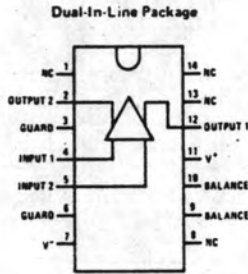
Medium Speed* General Purpose Amplifier



Increased Common-Mode Range at High Operating Currents

LM121/LM221/LM321,
LM121A/LM221A/LM321A

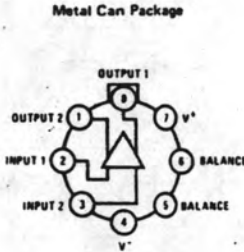
Connection Diagrams



NOTE: Pin 7 connected to bottom of package.

TOP VIEW

Order Number LM121D,
LM221D, LM221AD
or LM321AD
See NS Package D14E

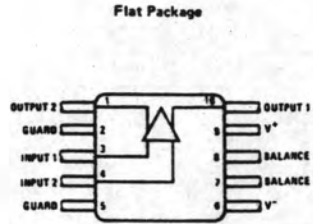


Note: Pin 4 connected to case.

TOP VIEW

Order Number LM121H,
LM221H, LM321H, LM121AH,
LM221AH or LM321AH
See NS Package H08C

Note: Outputs are inverting from
the input of the same number.

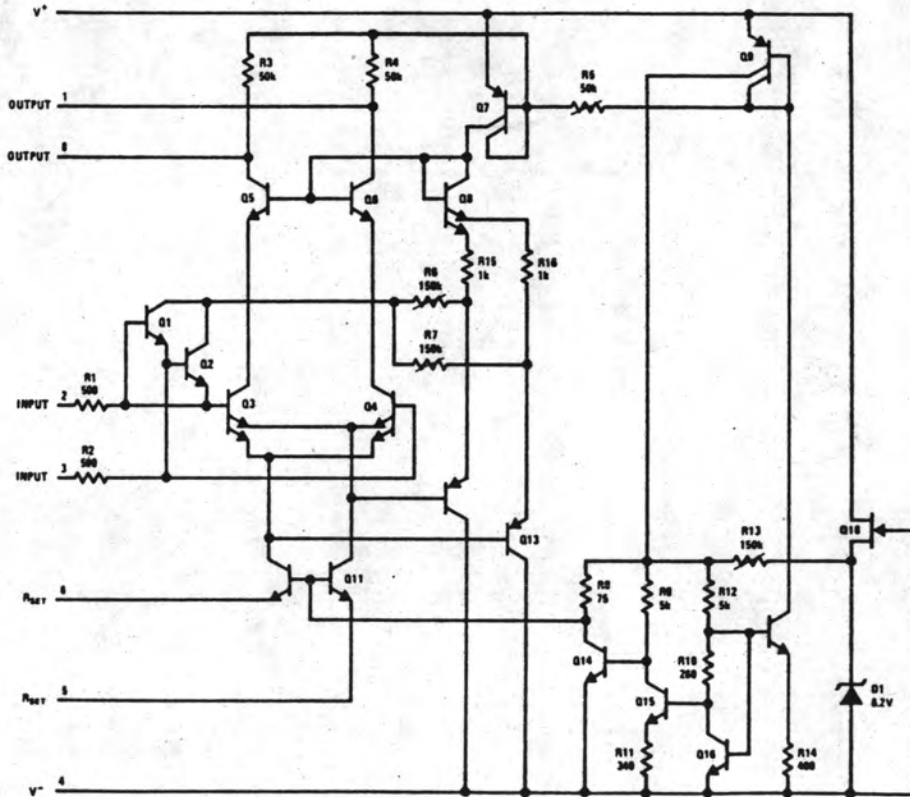


NOTE: Pin 6 connected to bottom of package.

TOP VIEW

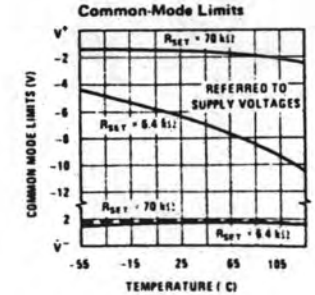
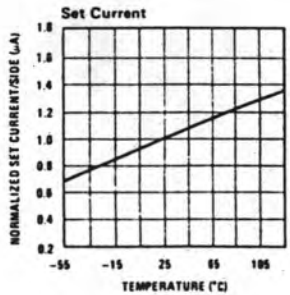
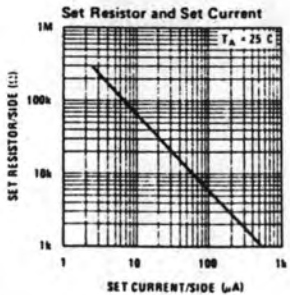
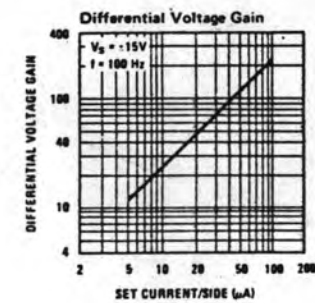
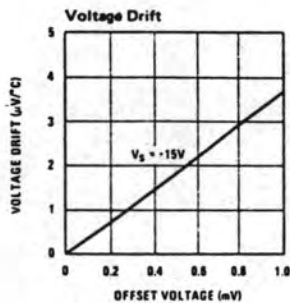
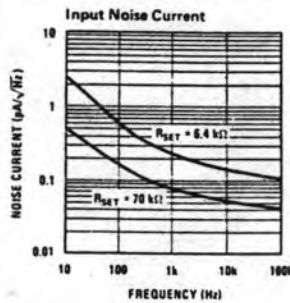
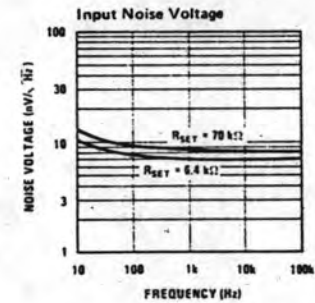
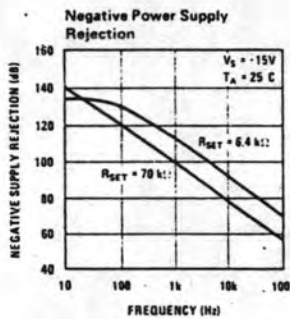
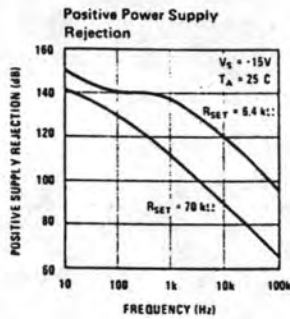
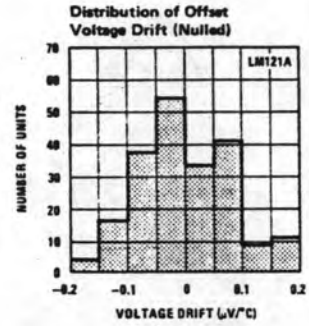
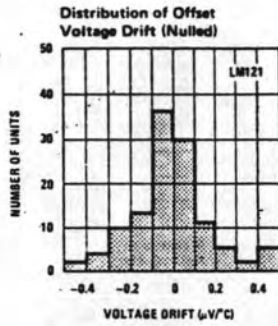
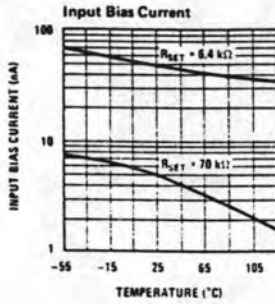
Order Number LM221F,
LM321F, LM221AF
or LM321AF
See NS Package F10A

Schematic Diagram*



*Pin connections shown on schematic diagram and typical applications are for TO 5 package.

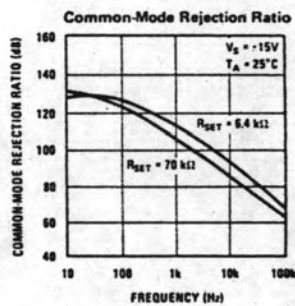
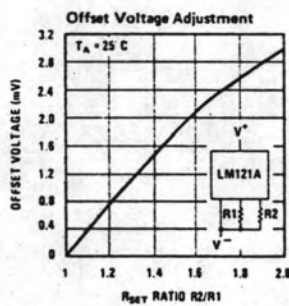
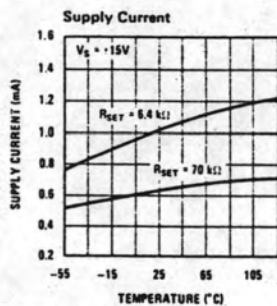
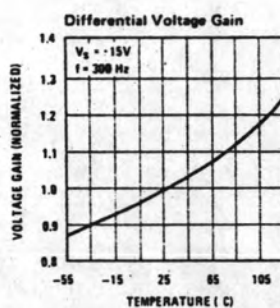
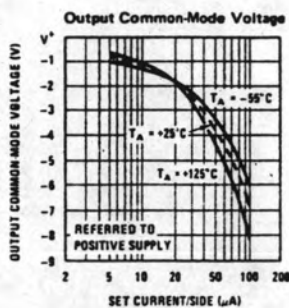
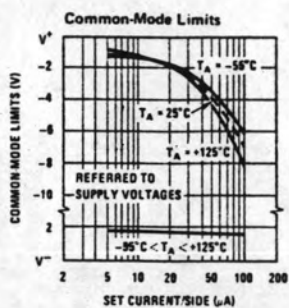
Typical Performance Characteristics



4

LM121/LM221/LM321.
LM121A/LM221A/LM321A

Typical Performance Characteristics (Continued)





ICL7109 12 Bit Binary A/D Converter for Microprocessor Interfaces

FEATURES

- 12 bit binary (plus polarity and overrange) dual slope integrating analog-to-digital converter.
- Byte-organized TTL-compatible three-state outputs and UART handshake mode for simple parallel or serial interfacing to microprocessor systems.
- RUN/HOLD input and STATUS output can be used to monitor and control conversion timing.
- True differential input and differential reference.
- Low noise — typically $15\mu\text{V p-p}$.
- 1pA typical input current.
- Operates at up to 30 conversions per second.
- On-chip oscillator operates with inexpensive 3.58MHz TV crystal giving 7.5 conversions per second for 60Hz rejection. May also be operated as RC oscillator for other clock frequencies.
- Fabricated using MAX-CMOS™ technology combining analog and digital functions on a single low power LSI CMOS chip.
- All inputs fully protected against static discharge; no special handling precautions necessary.

GENERAL DESCRIPTION

The ICL7109 is a high performance, low power integrating A/D converter designed to easily interface with microprocessors.

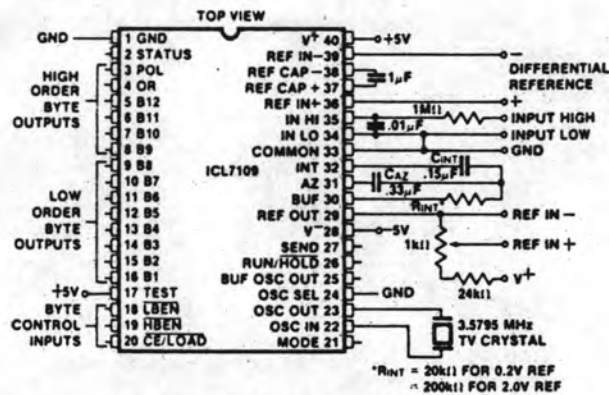
The output data (12 bits, polarity and overrange) may be directly accessed under control of two byte enable inputs and a chip select input for a simple parallel bus interface. A UART handshake mode is provided to allow the ICL7109 to work with industry-standard UARTs in providing serial data transmission, ideal for remote data logging applications. The RUN/HOLD input and STATUS output allow monitoring and control of conversion timing.

The ICL7109 provides the user with the high accuracy, low noise, low drift, versatility and economy of the dual-slope integrating A/D converter. Features like true differential input and reference, drift of less than $1\mu\text{V}/^\circ\text{C}$, maximum input bias current of 10pA , and typical power consumption of 20mW make the ICL7109 an attractive per-channel alternative to analog multiplexing for many data acquisition applications.

4

PIN CONFIGURATION AND TEST CIRCUIT:

(See Figure 1 for typical connection to a UART or Microcomputer)



(OUTLINE DWGS DL, JL, PL)

ORDERING INFORMATION

Part	Temp. Range	Package	Order Number
7109	-55°C to +125°C	40-Pin Ceramic DIP	ICL7109MDL
7109	-20°C to +85°C	40-Pin Ceramic DIP	ICL7109IDL
7109	-20°C to +85°C	40-Pin CERDIP	ICL7109IJL
7109	0°C to 70°C	40-Pin Plastic DIP	ICL7109CPL

ICL7109



ABSOLUTE MAXIMUM RATINGS

Positive Supply Voltage (GND to V ⁺)	+6.2V
Negative Supply Voltage (GND to V ⁻)	-9V
Analog Input Voltage (Lo or Hi) (Note 1)	V ⁺ to V ⁻
Reference Input Voltage (Lo or Hi) (Note 1)	V ⁺ to V ⁻
Digital Input Voltage (Pins 2-27) (Note 2)	V ⁺ + 0.3V GND - 0.3V
Power Dissipation (Note 3)	
Ceramic Package	1W @ +85°C
Plastic Package	500mW @ +70°C
Operating Temperature	
Ceramic Package (MDL)	-55°C ≤ T _A ≤ +125°C
(IDL)	-25°C ≤ T _A ≤ +85°C
Plastic Package (CPL)	0°C ≤ T _A ≤ +70°C
Storage Temperature	-55°C ≤ T _A ≤ +125°C
Lead Temperature (soldering, 60 sec.)	+300°C

*COMMENT: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the devices. This is a stress rating only and functional operation of the devices at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

TABLE I OPERATING CHARACTERISTICS

All parameters with V⁺ = +5V, V⁻ = -5V, GND = 0V, T_A = 25°C, unless otherwise indicated.
Test circuit as shown on page 1.

ANALOG SECTION

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Zero Input Reading		V _{IN} = 0.0V Full Scale = 409.6mV	-0000 ₈	±0000 ₈	+0000 ₈	Octal Reading
Ratiometric Reading		V _{IN} = V _{REF} V _{REF} = 204.8mV	3777 ₈	3777 ₈ 4000 ₈	4000 ₈	Octal Reading
Non-Linearity (Max deviation from best straight line fit)		Full Scale = 409.6mV to 4.096V Over full operating temperature range.	-1	±.2	+1	Counts
Roll-over Error (difference in reading for equal pos. and neg. inputs near full scale)		Full Scale = 409.6mV to 4.096V Over full operating temperature range.	-1	±.2	+1	Counts
Common Mode Rejection Ratio	CMRR	V _{CM} ±1V V _{IN} = 0V Full Scale = 409.6mV		50		μV/V
Input Common Mode Range	V _{CMR}	Input Hi, Input Lo, Common	V ⁻ +1.5		V ⁻ -1.0	V
Noise (p-p value not exceeded 95% of time)	e _n	V _{IN} = 0V Full Scale = 409.6mV		15		μV
Leakage current at Input	I _{ILK}	V _{IN} = 0 All devices 25°C ICL7109CPL 0°C ≤ T _A ≤ +70°C ICL7109IDC -25°C ≤ T _A ≤ +85°C ICL7109MDL -55°C ≤ T _A ≤ +125°C		1 20 100 2	10 100 250 5	pA pA pA nA
Zero Reading Drift		V _{IN} = 0V		0.2	1	μV/°C
Scale Factor Temperature Coefficient		V _{IN} = 408.9mV = > 7770 ₈ reading Ext. Ref. 0 ppm/°C		1	5	ppm/°C
Supply Current V ⁺ to GND	I ⁺	V _{IN} = 0, Crystal Osc. 3.58MHz test circuit		700	1500	μA
Supply Current V ⁺ to V ⁻	I _{SUPP}	Pins 2-21, 25, 26, 27, 29, open		700	1500	μA
Ref Out Voltage	V _{REF}	Referred to V ⁺ , 25kΩ between V ⁺ and REF OUT	-2.4	-2.8	-3.2	V
Ref Out Temp. Coefficient		25kΩ between V ⁺ and REF OUT		80		ppm/°C
Input Common Mode Range	V _{CM}	IN HI, IN LO, COMMON	V ⁻ + 1.5	V ⁺ - 0.5 to V ⁻ + 1.0	V ⁺ - 1.0	V

ICL7109



DIGITAL SECTION

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Voltage	V _{OH}	I _{OUT} = 100μA Pins 2-16, 18, 19, 20	3.5	4.3		V
Output Low Voltage	V _{OL}	I _{OUT} = 1.6mA		0.2	0.4	V
Output Leakage Current		Pins 3-16 high impedance		±0.1	±1	μA
Control I/O Pullup Current		Pins 18, 19, 20 V _{OUT} = V* -3V MODE input at GND		5		μA
Control I/O Loading		HBEN Pin 19 LBEN Pin 18			50	pF
Input High Voltage	V _{IH}	Pins 18-21, 26, 27 referred to GND	2.5			V
Input Low Voltage	V _{IL}	Pins 18-21, 26, 27 referred to GND			1	V
Input Pull-up Current		Pins 26, 27 V _{OUT} = V* -3V		5		μA
Input Pull-up Current		Pins 17, 24 V _{OUT} = V* -3V		25		μA
Input Pull-down Current		Pin 21 V _{OUT} = GND +3V		5		μA
Oscillator Output Current	High	O _{OH}	V _{OUT} = 2.5V	1		mA
	Low	O _{OL}	V _{OUT} = 2.5V	1.5		mA
Buffered Oscillator Output Current	High	BO _{OH}	V _{OUT} = 2.5V	2		mA
	Low	BO _{OL}	V _{OUT} = 2.5V	5		mA
MODE Input Pulse Width	t _w		50			ns

4

Note 1: Input voltages may exceed the supply voltages provided the input current is limited to ±100μA

Note 2: Due to the SCR structure inherent in the process used to fabricate these devices, connecting any digital inputs or outputs to voltages greater than V* or less than GND may cause destructive device latchup. For this reason it is recommended that no inputs from sources other than the same power supply be applied to the ICL7109 before its power supply is established, and that in multiple supply systems the supply to the ICL7109 be activated first.

Note 3: This limit refers to that of the package and will not be obtained during normal operation.

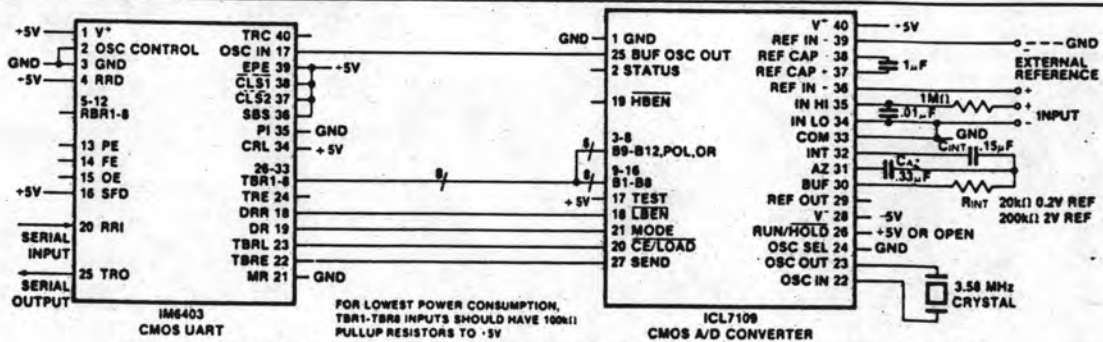


Figure 1A. Typical Connection Diagram UART Interface - To transmit latest result, send any word to UART

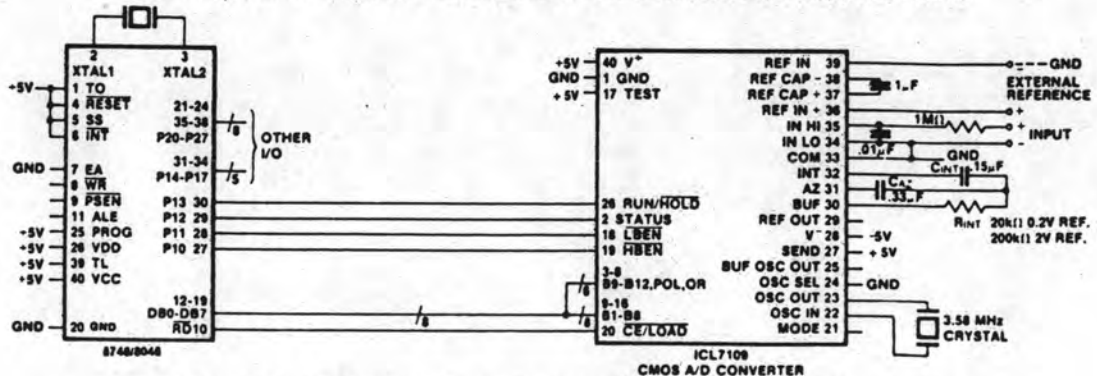


Figure 1B: Typical Connection Diagram Parallel Interface With MCS-48 Microcomputer

ICL7109



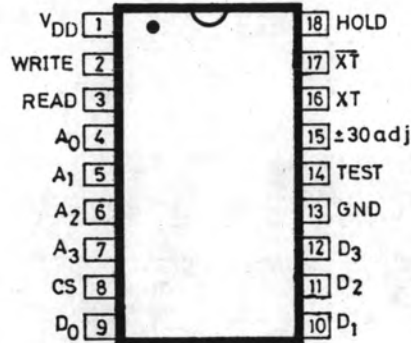
TABLE 2 - Pin Assignment and Function Description

PIN	SYMBOL	DESCRIPTION
1	GND	Digital Ground. 0V. Ground return for all digital logic
2	STATUS	Output High during integrate and deintegrate until data is latched. Output Low when analog section is in Auto-Zero configuration.
3	POL	Polarity - HI for Positive Input.
4	OR	Overrange - HI if Overranged.
5	B12	Bit 12 'Most Significant Bit'
6	B11	Bit 11
7	B10	Bit 10
8	B9	Bit 9
9	B8	Bit 8
10	B7	Bit 7
11	B6	Bit 6
12	B5	Bit 5
13	B4	Bit 4
14	B3	Bit 3
15	B2	Bit 2
16	B1	Bit 1 'Least Significant Bit'
17	TEST	Input High - Normal Operation. Input Low - Forces all bit outputs high. Note: This input is used for test purposes only. Tie high if not used.
18	LBEN	Low Byte Enable - With Mode (Pin 21) low, and CE/LOAD (Pin 20) low, taking this pin low activates low order byte outputs B1-B8. - With Mode (Pin 21) high, this pin serves as a low byte flag output used in handshake mode. See Figures 7, 8, 9
19	HBEN	High Byte Enable - With Mode (Pin 21) low, and CE/LOAD (Pin 20) low, taking this pin low activates high order byte outputs B9-B12, POL, OR. - With Mode (Pin 21) high, this pin serves as a high byte flag output used in handshake mode. See Figures 7, 8, 9
20	CE/LOAD	Chip Enable Load - With Mode (Pin 21) low, CE/LOAD (Pin 20) low, taking this pin low activates high order byte outputs B9-B12, POL, OR outputs are disabled. - With Mode (Pin 21) high, this pin serves as a load strobe used in handshake mode. See Figures 7, 8, 9

Note: All digital levels are positive true

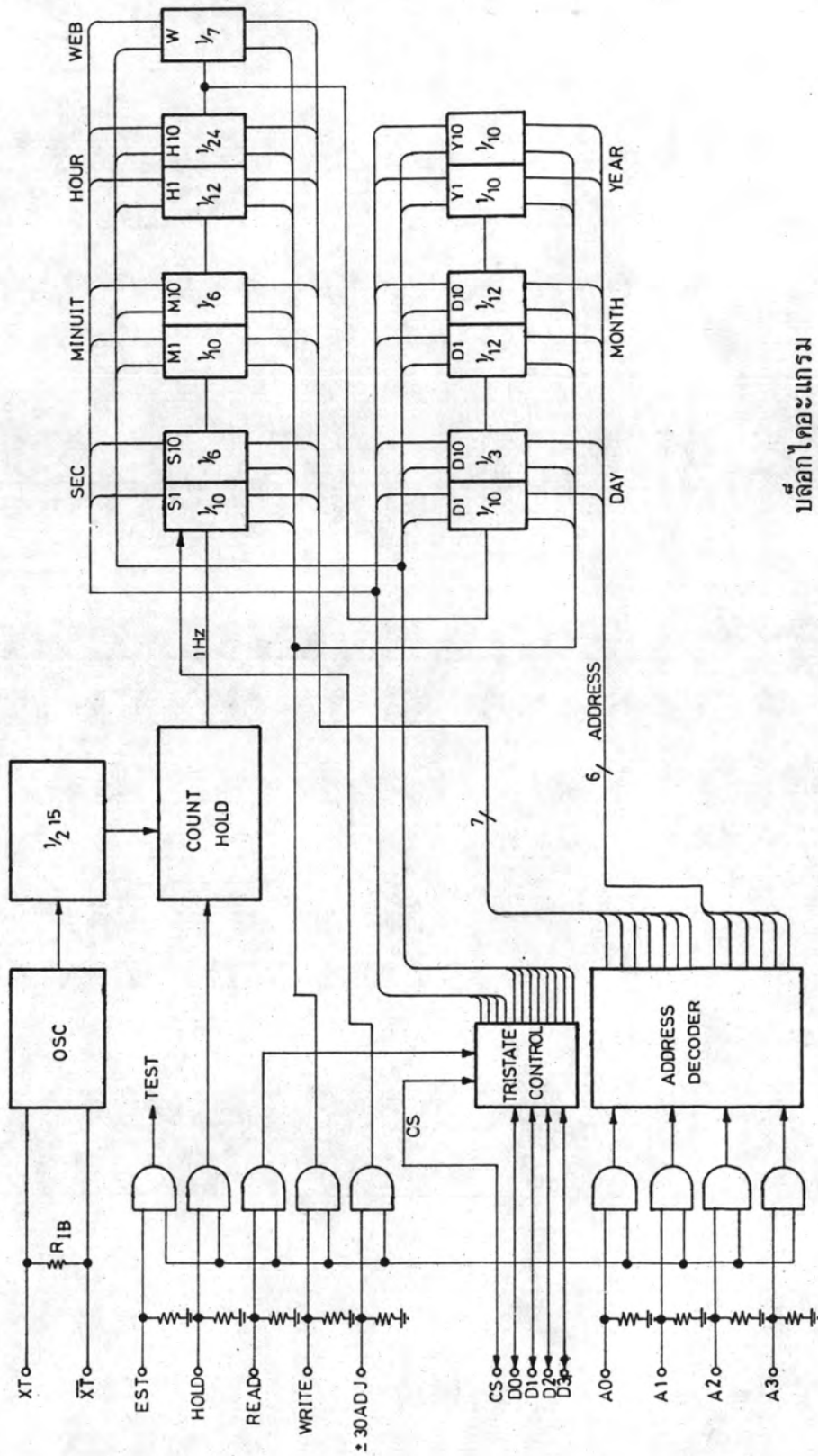
PIN	SYMBOL	DESCRIPTION
21	MODE	Input Low - Direct output mode where CE/LOAD (Pin 20), HBEN (Pin 19) and LBEN (Pin 18) act as inputs directly controlling byte outputs. Input Pulsed High - Causes immediate entry into handshake mode and output of data as in Figure 9. Input High - Enables CE/LOAD (Pin 20), HBEN (Pin 19), and LBEN (Pin 18) as outputs. Handshake mode will be entered and data output as in Figures 7 and 8 at conversion completion.
22	OSC IN	Oscillator Input
23	OSC OUT	Oscillator Output
24	OSC SEL	Oscillator Select - Input high configures OSC IN, OSC OUT, BUF OSC OUT as RC oscillator - clock will be same phase and duty cycle as BUF OSC OUT. - Input low configures OSC IN, OSC OUT for crystal oscillator - clock frequency will be 1/58 of frequency at BUF OSC OUT.
25	BUF OSC OUT	Buffered Oscillator Output
26	RUN/HOLD	Input High - Conversions continuously performed every 8192 clock pulses. Input Low - Conversion in progress completed, converter will stop in Auto-Zero 7 counts before integrate.
27	SEND	Input - Used in handshake mode to indicate ability of an external device to accept data. Connect to +5V if not used.
28	V	Analog Negative Supply - Nominally -5V with respect to GND (Pin 1)
29	REF OUT	Reference Voltage Output - Nominally 2.8V down from V ⁺ (Pin 40)
30	BUFFER	Buffer Amplifier Output
31	AUTO-ZERO	Auto-Zero Node - Inside foil of C _{AZ}
32	INTEGRATOR	Integrator Output - Outside foil of C _{INT}
33	COMMON	Analog Common - System is Auto-Zeroed to COMMON
34	INPUT LO	Differential Input Low Side
35	INPUT HI	Differential Input High Side
36	REF IN +	Differential Reference Input Positive
37	REF CAP +	Reference Capacitor Positive
38	REF CAP -	Reference Capacitor Negative
39	REF IN -	Differential Reference Input Negative
40	V ⁺	Positive Supply Voltage - Nominally +5V with respect to GND (Pin 1).

MSM5832



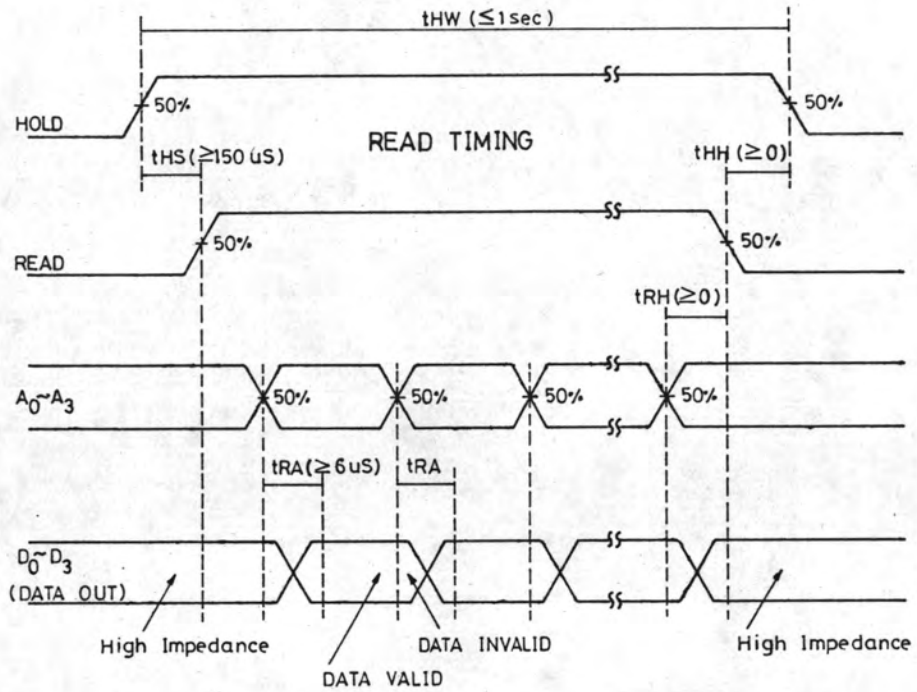
- ขา 1 V_{DD} ขาไฟบวก ใช้ได้จาก 2.2-7 volt
- ขา 2 WRITE ใช้งานร่วมกับขา 3 READ โดยเมื่อต้องการจะเซตเวลา หรือตั้งเวลา ก็ให้ WRITE "HIGH" และ "READ" LOW และกลับกันถ้าต้องการอ่านเวลาก็ให้เซต WRITE "LOW" และ READ "HIGH"
- ขา 4-7, A₀-A₃ เป็นแอดเดรสในการเลือกว่าต้องการเขียนหรืออ่านข้อมูลที่ใด
- ขา 8 CS (Chip select) ในการอ่าน, เขียน หรือใช้ Chip นี้ ต้องเซต CS ให้ "HIGH" ถ้า CS "LOW" ชิพก็ไม่ถูกเลือก
- ขา 9-12 เป็นข้อมูลซึ่งจะขึ้นอยู่กับ A₀-A₃ และ CS
- ขา 13 กราวนด์เป็นซากกราวนด์
- ขา 14 TEST ใช้ทดสอบวงจรในการใช้งานจะต่อกับกราวนด์
- ขา 15 ± 30ADJ ใช้เซตเวลาช่วง 30 วินาทีโดยถ้าเวลาขณะนั้นอยู่ระหว่าง 0 29 จะเซตเป็น 0 และถ้ามากกว่า 30 59 จะเซตโดยบวกอีก 1 นาที
- ขา 16-17 XT, XT เป็นขาที่ต่อกับคริสตัลความถี่ 32.768 KHz
- ขา 18 HOLD ขานี้แอดคิฟ High จะทำการหยุดนาฬิกาไว้ เพื่อให้สามารถเขียนหรืออ่านได้โดยตัวเลขไม่เปลี่ยนแปลง

MSM5832

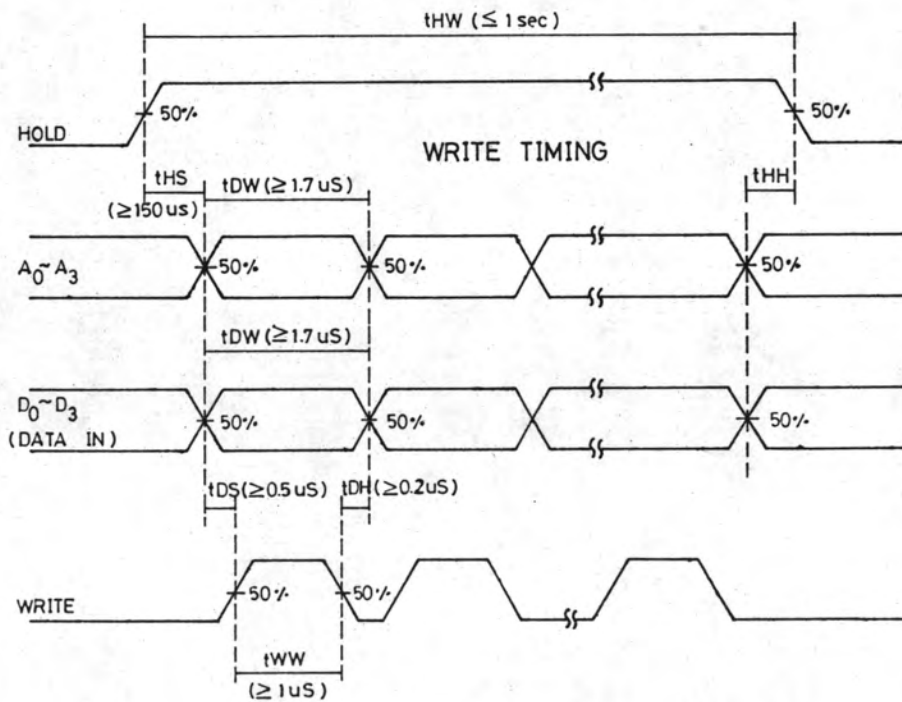


บล็อกโต๊ะเมตร

MSM5832



ไทมิ่งการอ่านและเขียนข้อมูล



แอดเดรสของข้อมูลตัวเลขวันที่และเวลา

แอดเดรส					เลือก	ข้อมูล				ข้อมูล	หมายเหตุ	MSM5832
A ₃	A ₂	A ₁	A ₀	Hex		D ₃	D ₂	D ₁	D ₀			
0	0	0	0	0	S1	*	*	*	*	0-9	เมื่อมีสัญญาณมา WRITE S1 และ S10 D0-D4 จะถูกเทเป็น "0" หมดเลย	S : วันอาทิตย์ M : นาที H : ชั่วโมง W : วันของสัปดาห์ D : วันที่ M : เดือน Y : ค.ศ.
0	0	0	1	1	S10		*	*	*	0-5		
0	0	1	0	2	M1	*	*	*	*	0-9		
0	0	1	1	3	M10		*	*	*	0-5		
0	1	0	0	4	H1	*	*	*	*	0-9		
0	1	0	1	5	H10	0	0	*	*	0-1 0-2	D2 "H" = PM, "L" = AM D3 "H" = 24 ชม. "L" = 12 ชม.	
0	1	1	0	6	W		*	*	*	0-6		
0	1	1	1	7	D1	*	*	*	*	0-9		
1	0	0	0	8	D10		0	*	*	0-3	D2 "H" เดือนก.พ. มี 29 วัน D2 "L" เดือนก.พ. มี 28 วัน	
1	0	0	1	9	M1	*	*	*	*	0-9		
1	0	1	0	A	M10				*	0-1		
1	0	1	1	B	Y1	*	*	*	*	0-9		
1	1	0	0	C	Y10	*	*	*	*	0-9		

ภาคผนวก ง. โปรแกรมการรับข้อมูลจากระบบเก็บข้อมูลแบบอะนาล็อก

โปรแกรมภาษาเบสิก

```

LIST

```

```

10 REM PROGRAM ADAS
20 REM THIS PROGRAM COMMUNICATE WITH ANALOG DATA ACQUISITION SYSTEM
30 REM VIA RS232C SERIAL COMMUNICATION WITH DEF PROTOCOL
40 HIMEM = 16384
50 PRINT CHR$(4);"BLOAD RS232C.OBJ"
60 D = ASC ("D");P = ASC ("P")
70 CALL 16384
80 REM SELECTION
90 HOME : PRINT "ANALOG DATA ACQUISITION SYSTEM": PRINT
100 PRINT : PRINT " (1)...ENQ FOR DATA "
110 PRINT : PRINT " (2)...ENQ FOR PROGRAM DATA "
120 PRINT : PRINT : PRINT "SELECT ONE";: GET A$: PRINT
130 ON VAL (A$) GOTO 1000,2000
140 PRINT " ": GOTO 90
1000 REM ENQ FOR DATA
1010 POKE 782,0
1020 POKE 784,D: CALL 16387: PRINT "ENQ DATA"
1030 CALL 16393
1040 IF PEEK (782) < > 0 THEN PRINT "CHECKSUM ERR"
1050 CNT = 0:B$ = CHR$(13):L$ = CHR$(10)
1060 C$ = CHR$( PEEK (16640 + CNT))
1070 IF C$ = B$ THEN PRINT "": GOTO 1110
1080 IF C$ = L$ THEN PRINT " ":
1090 PRINT C$;
1100 CNT = CNT + 1: GOTO 1060
1110 PRINT : PRINT "PRESS ANY KEY";: GET A$: GOTO 70
2000 REM ENQ FOR PROGRAM DATA
2010 POKE 782,0
2020 POKE 784,P: CALL 16387: PRINT "ENQ PROGRAM DATA"
2030 GOTO 1030

```


โปรแกรมภาษาแอสเอ็มบลี CPU 6502

:ASM

```

1000 *-----
1010 * RS-232C COMMUNICATION
1020 *-----
1030 *
1040 * DEF BUFFER AND CONSTANTS
C098: 1050 REG .EQ $C098 ;UART 6551 REG ADDR
C099: 1060 STATUS .EQ $C099
C09A: 1070 CMDREG .EQ $C09A ;COMMAND REG
C09B: 1080 CTRLRG .EQ $C09B ;CONTROL REG
0308: 1090 PAR .EQ $308 ;PARITY CHECK SUM BYTE 782
0309: 1100 ERCNT .EQ $309 ;ERROR COUNT 783
0310: 1110 TXD .EQ $310 ;TX DATA BUF 784
0311: 1120 RXD .EQ $311 ;RX DATA BUF 785
0312: 1130 ERR .EQ $312 ;ERROR BYTE 786
0313: 1140 WAIT .EQ $313 ;TIME DELAY COUNT 787
00FA: 1150 RBUF .EQ $FA ;RECEIVE DATA STREAM BUFFER INDEX
8100: 1160 TBUF .EQ $8100 ;TRANSMIT DATA STREAM BUFFER
1170 *-----
1180 * ENTRY POINT
1190 *-----
1200 .OR $4000
4000: 4C 0F 40 1210 J1 JMP INIT ;16384
4003: 4C 1F 40 1220 J2 JMP TX ;16387
4006: 4C 2F 40 1230 J3 JMP RX ;16390
4009: 4C 47 40 1240 J4 JMP RDATA ;16393
400C: 4C 87 40 1250 J5 JMP TDATA ;16396
1260 *-----
1270 * INITIALIZE 6551
1280 *-----
400F: A9 00 1290 INIT LDA #$00
4011: 8D 99 C0 1300 STA STATUS ;RESET
4014: A9 9A 1310 LDA #$9A ;10011010B
4016: 8D 9B C0 1320 STA CTRLRG ;B BIT 1 START/STOP
4019: A9 6B 1330 LDA #$6B ;01100011B
401B: 8D 9A C0 1340 STA CMDREG ;EVEN PARITY
401E: 60 1350 RTS
1360 *-----
1370 * TRANSMIT 1 BYTE DATA
1380 *-----
401F: AD 99 C0 1390 TX LDA STATUS ;CHECK TX READY
4022: 0A 1400 ASL
4023: 0A 1410 ASL
4024: 0A 1420 ASL
4025: 0A 1430 ASL
4026: 90 F7 1440 BCC TX
4028: AD 10 03 1450 LDA TXD ;SEND DATA
402B: 8D 9B C0 1460 STA REG
402E: 60 1470 RTS

```



```

1480 *-----
1490 * RECEIVE 1 BYTE DATA
1500 *-----
402F: AD 99 C0 1510 RX   LDA STATUS ;CHECK RECEIVE READY BIT
4032: 4A          1520   LSR
4033: 4A          1530   LSR
4034: 4A          1540   LSR
4035: 4A          1550   LSR
4036: 90 F7      1560   BCC RX
4038: AD 99 C0 1570   LDA STATUS ;LOAD ERR BIT
4038: 29 07      1580   AND #$07
403D: 8D 12 03 1590   STA ERR
4040: AD 98 C0 1600   LDA REG ;READ DATA
4043: 8D 11 03 1610   STA RXD
4046: 60          1620   RTS
1630 *-----
1640 *RECEIVE STREAM OF DATA
1650 *ON RETURN
1660 *DATA STORE IN RBUF
1670 *ERCNT = NO.OF ERROR BYTE
1680 *PAR (< )...PARITY ERROR
1690 *-----
4047: A2 00      1700 RDATA LDX #$00 ;INIT CNT & PAR
4049: A0 00      1710   LDY #$00
404B: 8E 09 03 1720   STX ERCNT
404E: 8E 08 03 1730   STX PAR
4051: A9 00      1740   LDA #$00
4053: 85 FA      1750   STA RBUF
4055: A9 41      1760   LDA #$41
4057: 85 FB      1770   STA RBUF+1
4059: 20 2F 40 1780 RD   JSR RX ;RECEIVE STREAM OF DATA
405C: AD 12 03 1790   LDA ERR ;TEST ERROR
405F: 09 00      1800   ORA #$00
4061: F0 03      1810   BEQ CONT
4063: EE 09 03 1820   INC ERCNT
4066: AD 11 03 1830 CONT LDA RXD
4069: C9 0D      1840   CMP #$0D ;COMPARE "CR"
406B: F0 10      1850   BEQ RET
406D: 91 FA      1860   STA (RBUF),Y
406F: 4D 08 03 1870   EOR PAR
4072: 8D 08 03 1880   STA PAR
4075: C8          1890   INY
4076: D0 E1      1900   BNE RD
4078: E6 FB      1910   INC RBUF+1
407A: 4C 59 40 1920   JMP RD
407D: 88          1930 RET DEY
407E: C8          1940   INY
407F: D0 02      1950   BNE PASS
4081: C6 FB      1960   DEC RBUF+1
4083: 88          1970 PASS DEY
4084: 91 FA      1980   STA (RBUF),Y
4086: 60          1990   RTS

```

2000 *-----
 2010 *TRANSMIT STREAM OF DATA FROM TBUF
 2020 *SEND PAR AND CR AT THE END OF TRANSMIION
 2030 *-----

4087:	A2 00	2040	TDATA	LDX #00	
4089:	8D 08 03	2050		STA PAR	
408C:	BD 00 81	2060	TD1	LDA TBUF,X	
408F:	C9 0D	2070		CMP #0D	
4091:	F0 11	2080		BEQ TD2	
4093:	8D 10 03	2090		STA TXD	
4096:	4D 08 03	2100		EOR PAR	;PARITY BYTE
4099:	8D 08 03	2110		STA PAR	
409C:	20 1F 40	2120		JSR TX	
409F:	A9 FF	2130		LDA #FF	
40A1:	8D 13 03	2140		STA WAIT	
40A4:	AD 08 03	2150	TD2	LDA PAR	;SEND PARITY
40A7:	8D 10 03	2160		STA TXD	
40AA:	20 1F 40	2170		JSR TX	
40AD:	A9 0D	2180		LDA #0D	;SEND "CR"
40AF:	8D 10 03	2190		STA TXD	
40B2:	20 1F 40	2200		JSR TX	

SYMBOL TABLE

C09A: CMDREG
 4066: CONT
 C09B: CTRLRG
 0309: ERCNT
 0312: ERR
 400F: INIT
 4000: J1
 4003: J2
 4006: J3
 4009: J4
 400C: J5
 0308: PAR
 4083: PASS
 00FA: RBUF
 4059: RD
 4047: RDATA
 C098: REG
 407D: RET
 402F: RX
 0311: RXD
 C099: STATUS
 8100: TBUF
 408C: TD1
 40A4: TD2
 4087: TDATA
 401F: TX
 0310: TXD
 0313: WAIT

0000 ERRORS IN ASSEMBLY

ภาคผนวก จ. PROGRAM LISTING

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```

1      0000'      ASEG
2                      ORG      2000H
3                      EXTERNAL FIRST,DISB,INTVTM,OPFUNC,PMOTM,PRNT,TIMED,SERIN,ADINT1,NOTPRG
4                      EXTERNAL CTRLP,SNDBUF,CHNSND,SDNTYP,CTRLS,XORST,XORBUF,FOUND,DCMSND
5                      EXTERNAL UNTSND,RAGSND,ADDAT,CUSCHN,LSTCU,REFST,REFCHN,BATT1
6                      EXTERNAL CHDIS,CHDISD,PRTM,RANGE,DATA,HLIMIT,LLIMIT,BATT2,STKPT,CKNPG
7                      .PHASE 0000H
8                      C          INCLUDE B:ADACQSY
9                      C ;*****
10                     C ;*  ANALOG DATA ACQUISITION SYSTEM  *
11                     C ;*****
12                     C ;MAIN PROGRAM
13                     C ;
14      0000      06 00*      C          LD      B,POWDLY##      ;DELAY POWER UP
15      0002      10 FE      C POWER:  DJNZ     POWER
16      0004      31 0000*   C          LD      SP,STKPT      ;SET STACK POINTER
17      0007      C3 001B    C          JP      CAINIT
18      000A                      C          DEFS      6
19      0010      001B      C INTRTN:  DEFW     CAINIT
20      0012      0000*      C          DEFW     ADINT##
21      0014      0000*      C          DEFW     SERINT##
22      0016      0000*      C          DEFW     SCNINT##
23      0018      CD 003B    C CAINIT:  CALL     INITIAL      ;INITIAL MEMORY
24      001B      CD 00BE    C          CALL     INIINTF     ;INITIAL I/D INTERFACE
25      001E      CD 0105    C          CALL     HEAD       ;DISPLAY AND PRINT HEAD WHEN POWER UP
26      0021      CD 0167    C          CALL     SELCHN     ;SELECT CHANNEL TO READ DATA
27      0024      CD 014E    C          CALL     INITDLY    ;INITIAL DELAY
28      0027      D3 00*     C          OUT     (START##),A ;START A/D
29      0029      AF          C          XOR      A          ;CLEAR A/D INTERRUPT STATUS
30      002A      32 0000*   C          LD      (ADINT1),A
31      002D      3E CF      C          LD      A,OCFH      ;SET CTC FOR A/D INTERRUPT
32      002F      D3 00*     C          OUT     (CTC1##),A
33      0031      3E 02      C          LD      A,02H      ;TIME CONSTANT
34      0033      D3 00*     C          OUT     (CTC1##),A
35      0035      C3 01A8    C          JP      PROC       ;KEY PROCESSING AND DATA PROCESSING
36                      C          INCLUDE B:INITIAL
37                      C ;*****
38                      C ;*      INITIAL MEMORY      *
39                      C ;*****
40                      C ;INITIAL STATUS BUFFER AND CHECK BATTERY BACK UP FOR INITIAL PROGRAM DATA
41                      C ;
42      0038      21 0000*   C INITIAL: LD      HL,FIRST      ;INITIAL BUFFER AND STATUS
43      003B      AF          C          XOR      A
44      003C      06 6F      C          LD      B,6FH
45      003E      CD 00B9    C          CALL     INIT1       ;INITIAL LOOP
46      0041      3E C0      C          LD      A,0C0H     ;SET TO PROGRAM MODE
47      0043      32 0000*   C          LD      (OPFUNC),A
48      0046      3A 0000*   C          LD      A,(BATT1)    ;CHECK BATTERY BACK UP
49      0049      FE AA      C          CP      0AAH
50      004B      20 06      C          JR      NZ,INIPRO    ;TO INITIAL PROGRAM DATA
51      004D      3A 0000*   C          LD      A,(BATT2)    ;DOUBLE CHECK
52      0050      FE AA      C          CP      0AAH
53      0052      C8          C          RET      Z
54      0053      3E AA      C INIPRO: LD      A,0AAH      ;SET BATTERY CHECK
55      0055      32 0000*   C          LD      (BATT1),A
56      0058      32 0000*   C          LD      (BATT2),A

```

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```

57 005B 3E 01 C LD A,01H
58 005D 32 0000* C LD (NOTPRG),A ;SET CHECK PROGRAM CHANNEL STATUS
59 0060 21 0000* C LD HL,CHDISD ;SET CHANNEL DISPLAY TO 001
60 0063 77 C LD (HL),A
61 0064 23 C INC HL
62 0065 AF C XOR A
63 0066 77 C LD (HL),A
64 0067 23 C INC HL
65 0068 77 C LD (HL),A
66 0069 32 0000* C LD (CHDIS),A
67 006C 21 0000* C LD HL,PRTM ;SET INTERVAL PRINT TIME PROGRAM
68 006F 06 04 C LD B,04H
69 0071 CD 00B9 C CALL INIT1
70 0074 21 0000* C LD HL,RANGE ;SET RANGE
71 0077 06 10 C LD B,10H
72 0079 CD 00B9 C CALL INIT1
73 007C 21 0000* C LD HL,DATA ;SET DATA
74 007F CD 00AB C CALL INIT3
75 0082 21 0000* C LD HL,LLIMIT ;SET LOW LIMIT
76 0085 CD 00AB C CALL INIT3
77 0088 21 0000* C LD HL,HLIMIT ;SET HIGH LIMIT
78 008B 06 00 C LD B,00H
79 008D CD 00B3 C CALL INIT2
80 0090 21 0001* C LD HL,HLIMIT+1
81 0093 3E C0 C LD A,0C0H
82 0095 06 00 C LD B,00H
83 0097 CD 00B3 C CALL INIT2
84 009A 21 001F* C LD HL,HLIMIT+31
85 009D 11 0020 C LD DE,0020H
86 00A0 AF C XOR A
87 00A1 06 10 C LD B,10H
88 00A3 77 C INIT4: LD (HL),A
89 00A4 19 C ADD HL,DE
90 00A5 10 FC C DJNZ INIT4
91 00A7 C9 C RET
92 00A8 06 00 C INIT3: LD B,00H
93 00AA CD 00B9 C CALL INIT1
94 00AD 06 00 C LD B,00H
95 00AF CD 00B9 C CALL INIT1
96 00B2 C9 C RET
97 00B3 77 C INIT2: LD (HL),A
98 00B4 23 C INC HL
99 00B5 23 C INC HL
100 00B6 10 FB C DJNZ INIT2
101 00BB C9 C RET
102 00B9 77 C INIT1: LD (HL),A
103 00BA 23 C INC HL
104 00BB 10 FC C DJNZ INIT1
105 00BD C9 C RET
106 C INCLUDE B:INIINTF
107 C ;*****
108 C ;* INITIAL I/O INTERFACE *
109 C ;*****
110 C ;SET CONTROL COMMAND TO I/O INTERFACE
111 C ;
112 00BE 21 0010 C INIINTF: LD HL,INTRTN ;SET INTERRUPT VECTOR

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```

113 00C1 7C C LD A,H
114 00C2 ED 47 C LD I,A
115 00C4 ED 5E C IM 2
116 00C6 3E 4F C LD A,4FH ;SET PIO TO INPUT MODE DISABLE INTERRUPT
117 00C8 D3 00* C OUT (PIOCA##),A
118 00CA D3 00* C OUT (PIOCB##),A
119 00CC 3E 03 C LD A,03H
120 00CE D3 00* C OUT (PIOCA##),A
121 00D0 D3 00* C OUT (PIOCB##),A
122 00D2 3E 89 C LD A,89H ;SET 8255 FOR CLOCK AND PRINTER
123 00D4 D3 00* C OUT (CTRL1##),A ;PORT A, PORT B = OUTPUT PORT C = INPUT
124 00D6 3E 80 C LD A,80H ;SET 8255 FOR SCAN AND ALARM
125 00D8 D3 00* C OUT (CTRL2##),A ;PORT A, PORT B, PORT C = OUTPUT
126 00DA 3E 90 C LD A,90H ;SET 8255 FOR DISPLAY
127 00DC D3 00* C OUT (CTRL3##),A ;PORT A = INPUT PORT B, PORT C = OUTPUT
128 00DE 7D C LD A,L ;SET CTC INTERRUPT VECTOR
129 00DF E6 F8 C AND OFBH
130 00E1 D3 00* C OUT (CTC0##),A
131 00E3 3E 05 C LD A,05H ;SET CTC FOR 8251 CLOCK
132 00E5 D3 00* C OUT (CTC0##),A
133 00E7 3E 03 C LD A,03H ;TIME CONSTANT
134 00E9 D3 00* C OUT (CTC0##),A
135 00EB 3E 9F C LD A,9FH ;SET CTC FOR SERIAL COMM. INTERRUPT
136 00ED D3 00* C OUT (CTC2##),A
137 00EF 3E 02 C LD A,02H ;TIME CONSTANT
138 00F1 D3 00* C OUT (CTC2##),A
139 00F3 3E 85 C LD A,85H ;SET CTC FOR DISPLAY INTERRUPT
140 00F5 D3 00* C OUT (CTC3##),A
141 00F7 3E 70 C LD A,70H ;TIME CONSTANT
142 00F9 D3 00* C OUT (CTC3##),A
143 00FB 3E 7E C LD A,7EH ;SET MODE 8251
144 00FD D3 00* C OUT (C8251##),A
145 00FF 3E 15 C LD A,15H ;SET STATUS 8251
146 0101 D3 00* C OUT (C8251##),A
147 0103 FB C EI
148 0104 C9 C RET
149 C INCLUDE B:HEAD
150 C ;*****
151 C ;* DISPLAY HEAD AND PRINT *
152 C ;*****
153 C ;DISLAY"EE-CHULA", DATE AND TIME
154 C ;PRINT"CHULALONGKORN UNIVERSITY", "ELECTRICAL ENGINEERING", DATE AND TIME
155 C ;
156 0105 21 0000* C HEAD: LD HL,HEADIS## ;DISPLAY FIXED FORMAT "EE-CHULA"
157 0108 11 0000* C LD DE,DISB
158 0108 01 0009 C LD BC,0009H
159 010E ED B0 C LDIR
160 0110 3E B0 C LD A,B0H ;INITIAL PRINTER
161 0112 D3 00* C OUT (PORTB1##),A
162 0114 3E 01 C LD A,01H ;PRINT ENLARGE " CHULALONGKORN "
163 0116 32 0000* C LD (CTRLS),A
164 0119 CD 015B C CALL ENLPRN ;SEND ENLARGE CONTROL PRINT
165 011C 21 0BB2 C LD HL,CHULA
166 011F CD 0B34 C CALL SNDFIX
167 0122 21 0BC6 C LD HL,UNIV ;PRINT ENLARGE " UNIVERSITY "
168 0125 CD 0B34 C CALL SNDFIX

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```

169 012B AF C XOR A
170 0129 32 0000* C LD (CTRLS),A
171 012C 21 0BDA C LD HL,ELECT ;PRINT " ELECTRICAL "
172 012F CD 0834 C CALL SNDFIX
173 0132 21 0BEE C LD HL,ENGIN ;PRINT "ENGINEERING "
174 0135 CD 0834 C CALL SNDFIX
175 0138 CD 014E C CALL INITDLY ;DELAY
176 013B CD 0269 C CALL READTM ;READ TIME
177 013E CD 0000* C CALL DATHLD## ;DISPLAY DATE
178 0141 CD 014E C CALL INITDLY
179 0144 CD 0000* C CALL TIMHLD## ;DISPLAY TIME
180 0147 CD 07DE C CALL SNDDATE ;PRINT DATE
181 014A CD 060D C CALL SNDTM ;PRINT TIME
182 014D C9 C RET
183 014E 06 04 C INITDLY: LD B,04H
184 0150 11 0000 C BDLY: LD DE,0000H
185 0153 1B C DLY: DEC DE
186 0154 7A C LD A,D
187 0155 B3 C OR E
188 0156 20 FB C JR NZ,DLY
189 0158 10 F6 C DJNZ BDLY
190 015A C9 C RET
191 015B 21 0000* C ENLPRN: LD HL,CTRLP
192 015E 36 0A C LD (HL),0AH ;LINE FEED
193 0160 23 C INC HL
194 0161 36 18 C LD (HL),18H ;CLEAR BUFFER
195 0163 23 C INC HL
196 0164 36 0E C LD (HL),0EH ;ENLARGE
197 0166 C9 C RET
198 C INCLUDE B:SELCHN
199 C ;*****
200 C ;* SELECT READ CHANNEL *
201 C ;*****
202 C ;CHANGE READ CHANNEL AND REFRESH DISPLAY CHANNEL 8 CH/TIME
203 C ;
204 0167 3A 0000* C SELCHN: LD A,(CUSCHN) ;MARK FOR DATA PROCESSING
205 016A 32 0000* C LD (LSTCU),A
206 016D 21 0000* C CBECHN: LD HL,CUSCHN ;CHANGE CHANNEL
207 0170 3A 0000* C LD A,(REFST) ;CHECK REFRESH STATUS
208 0173 FE 01 C CP 01H
209 0175 28 11 C JR Z,BCUCHN ;TO CURRENT SCAN CHANNEL
210 0177 35 C DEC (HL)
211 0178 7E C LD A,(HL) ;FIND INSERT REFRESH CHANNEL
212 0179 E6 07 C AND 07H
213 017B 28 15 C JR Z,REFSH ;TO REFRESH CHANNEL
214 017D CD 0000* C CAPASS: CALL PASS## ;CHECK USE CHANNEL
215 0180 20 EB C JR NZ,CBECHN
216 0182 3A 0000* C DCHN: LD A,(CUSCHN)
217 0185 D3 00* C OUT (PORTB2##),A
218 0187 C9 C RET
219 0188 3A 0000* C BCUCHN: LD A,(REFCHN) ;BACK TO CURRENT SCAN CHANNEL
220 018B 77 C LD (HL),A
221 018C AF C XOR A
222 018D 32 0000* C LD (REFST),A ;RESET REFRESH STATUS
223 0190 18 EB C JR CAPASS
224 0192 3A 0000* C REFSH: LD A,(NOTPRG) ;CHECK PROGRAM CHANNEL

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```

225 0195 FE 01 C CP 01H
226 0197 28 E4 C JR Z,CAPASS
227 0199 7E C LD A,(HL) ;CHANGE TO READ DISPLAY CHANNEL
228 019A 32 0000* C LD (REFCHN),A
229 019D 3A 0000* C LD A,(CHDIS)
230 01A0 77 C LD (HL),A
231 01A1 3E 01 C LD A,01H ;SET REFRESH STATUS
232 01A3 32 0000* C LD (REFST),A
233 01A6 18 DA C JR OCHN
234 C INCLUDE B:PROC
235 C ;*****
236 C ;* SYSTEM PROCESSING *
237 C ;*****
238 C ;DISPLAY AND PRINT DATA CORRESPONDED TO KEY OPERATED FUNCTION
239 C ;CHECK PRINT COMMAND, PRINT MODE AND TIME, HOLD PRINT, PROGRAM PRINT
240 C ;CHECK A/D INTERRUPT AND PROCESSING DATA
241 C ;
242 01A8 3E 01 C PROC: LD A,01H
243 01AA D3 00* C OUT (PORTA2##),A
244 01AC CD 0269 C CALL READTM ;READ TIME
245 01AF 3E 02 C LD A,02H
246 01B1 D3 00* C OUT (PORTA2##),A
247 01B3 CD 024E C CALL CKINT ;CHECK A/D INTERRUPT
248 01B6 3A 0000* C LD A,(CKNP6) ;CHECK NO. PROGRAM STATUS
249 01B9 FE 01 C CP 01H
250 01BB 20 24 C JR NZ,PASS7 ;NO STATUS TO FUNCTION DISPLAY
251 01BD 21 0001* C LD HL,HLINT+1 ;CHECK HAVE ONE CHANNEL PROGRAM OR NOT
252 01C0 06 00 C LD B,00H
253 01C2 16 10 C LD D,10H
254 01C4 AF C NXT: XOR A
255 01C5 BA C CP D
256 01C6 20 02 C JR NZ,PASS4
257 01C8 16 10 C LD D,10H
258 01CA 15 C PASS4: DEC D
259 01CB 28 05 C JR Z,PASS5
260 01CD 7E C LD A,(HL)
261 01CE E6 C0 C AND 0C0H
262 01D0 28 0B C JR Z,PASS3 ;HAVE CHANNEL PROGRAM TO FUNCTION DISPLAY
263 01D2 23 C PASS5: INC HL
264 01D3 23 C INC HL
265 01D4 10 EE C DJNZ NXT
266 01D6 3E 01 C LD A,01H ;SET NO ANY PROGRAM STATUS
267 01D8 32 0000* C LD (NOTPRG),A
268 01DB 18 04 C JR PASS7
269 01DD AF C PASS3: XOR A
270 01DE 32 0000* C LD (NOTPRG),A
271 01E1 3E 04 C PASS7: LD A,04H
272 01E3 D3 00* C OUT (PORTA2##),A
273 01E5 CD 0000* C CALL FUNDIS## ;OPERATED FUNCTION DISPLAY
274 01E8 3E 0B C LD A,0BH
275 01EA D3 00* C OUT (PORTA2##),A
276 01EC CD 024E C CALL CKINT
277 01EF 3A 0000* C LD A,(PMOTM) ;CHECK PRINT MODE AND TIME COMMAND
278 01F2 FE 01 C CP 01H
279 01F4 20 07 C JR NZ,CKPRNT ;NOT TO CHECK HOLD AND PROGRAM PRINT
280 01F6 CD 05CC C CALL PRMOTM ;TO PRINT MODE AND TIME

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```

281 01F9 AF C XOR A ;RESET COMMAND
282 01FA 32 0000* C LD (PMOTM),A
283 01FD 3E 10 C CKPRNT: LD A,10H
284 01FF D3 00* C OUT (PORTA2##),A
285 0201 CD 024E C CALL CKINT
286 0204 3A 0000* C LD A,(PRNT) ;CHECK HOLD AND PROGRAM PRINT
287 0207 3C C INC A
288 0208 2B 3F C JR Z,PRGM ;(PRNT) = 0FFH TO PROGRAM PRINT
289 020A 3D C DEC A
290 020B C4 06EB C CALL NZ,HLDPRN ;(PRNT) = 01H TO HOLD PRINT
291 020E AF C NOPRNT: XOR A ;RESET COMMAND
292 020F 32 0000* C LD (PRNT),A
293 0212 3E 20 C LD A,20H
294 0214 D3 00* C OUT (PORTA2##),A
295 0216 CD 024E C CALL CKINT
296 0219 3A 0000* C LD A,(INTVTM) ;CHECK INTERVAL PRINT COMMAND
297 021C FE 01 C CP 01H
298 021E CC 06EB C CALL Z,HLDPRN ;PRINT IN RUN MODE IS THE SAME FORMAT AS HOLD MODE
299 0221 AF C XOR A ;RESET COMMAND
300 0222 32 0000* C LD (INTVTM),A
301 0225 3E 40 C LD A,40H
302 0227 D3 00* C OUT (PORTA2##),A
303 0229 CD 024E C CALL CKINT
304 022C 3E 80 C LD A,80H
305 022E D3 00* C OUT (PORTA2##),A
306 0230 3A 0000* C LD A,(SERIN) ;CHECK SERIAL COMM. COMMAND
307 0233 FE 00 C CP 00H
308 0235 2B 0B C JR Z,NOSE
309 0237 CD 0AAD C CALL SERCOM ;SEND DATA TO RS 232-C PORT
310 023A 3E 9F C LD A,9FH
311 023C D3 00* C OUT (CTC2##),A
312 023E 3E 02 C LD A,02H
313 0240 D3 00* C OUT (CTC2##),A
314 0242 AF C NOSE: XOR A ;RESET COMMAND
315 0243 32 0000* C LD (SERIN),A
316 0246 C3 01AB C JP PROC ;NEXT LOOP
317 0249 CD 09D0 C PRGM: CALL PROPRN ;PROGRAM PRINT
318 024C 1B C0 C JR NOPRNT ;TO RESET PRINT COMMAND
319 024E 3A 0000* C CKINT: LD A,(ADINT1) ;CHECK END OF CONVERSION INTERRUPT
320 0251 FE 01 C CP 01H
321 0253 C0 C RET NZ ;NOT INTERRUPT STATUS
322 0254 CD 0167 C CALL SELCHN ;SELECT CHANNEL
323 0257 CD 028E C CALL DAPROC ;DATA PROCESSING
324 025A D3 00* C OUT (START##),A ;START A/D
325 025C AF C XOR A ;CLEAR A/D INTERRUPT STATUS
326 025D 32 0000* C LD (ADINT1),A
327 0260 3E CF C LD A,OCFH ;SET CTC FOR A/D INTERRUPT
328 0262 D3 00* C OUT (CTC1##),A
329 0264 3E 02 C LD A,02H ;TIME CONSTANT
330 0266 D3 00* C OUT (CTC1##),A
331 0268 C9 C RET
332 C INCLUDE B:READTM
333 C ;*****
334 C ;* READ TIME *
335 C ;*****
336 C ;READ TIME DATA FROM MSM 5832

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337          C ; READ SEC,MINUTE,HOURL,DATE,MONTH,YEAR
338          C ;
339 0269 21 0000* C READTM: LD HL,TIMED ;SET INDEX FOR TIME DATA ADDRESS
340 026C 0E A0 C LD C,0A0H ;SET CODE FOR READ TIME
341 026E 79 C LD A,C
342 026F D3 00* C NTRD: OUT (PORTB1##),A ;OUT CONTROL CODE AND ADDRESS CODE
343 0271 FE A5 C CP 0A5H ;CHECK ADDRESS IS HIGH BYTE OF HOUR OR NOT
344 0273 28 13 C JR Z,MHOUR ;IF IS HIGH BYTE OF HOUR TO MARK FOR USE 2 BITS
345 0275 DB 00* C IN A,(PORTC1##) ;READ DATA
346 0277 E6 0F C AND 0FH ;MARK DATA FOR USE 4 BITS
347 0279 77 C SAVETM: LD (HL),A ;SAVE DATA
348 027A 0C C INC C ;CHANGE TO READ THE NEXT DATA
349 027B 23 C INC HL ;CHANGE THE NEXT INDEX
350 027C 79 C LD A,C
351 027D FE A6 C CP 0A6H ;CHECK ADDRESS IS FOR WEEK
352 027F 20 02 C JR NZ,CKEND ;JUMP TO CHECK END IF NOT WEEK ADDRESS
353 0281 0C C INC C
354 0282 79 C LD A,C
355 0283 FE AD C CKEND: CP 0ADH ;CHECK END TIME DATA
356 0285 38 EB C JR C,NTRD ;NOT END TO THE NEXT READ CYCLE
357 0287 C9 C RET
358 0288 DB 00* C MHOUR: IN A,(PORTC1##) ;READ DATA
359 028A E6 03 C AND 03H ;MARK DATA FOR USE 2 BITS
360 028C 18 EB C JR SAVETM ;TO SAVE DATA
361          C
362          C INCLUDE B:DAPROC
363          C ;*****
364          C ;* DATA PROCESSING *
365          C ;*****
366          C ;SUBTRACT OFFSET
367          C ;CHANGE BINARY DATA TO BCD DATA
368          C ;
369 028E 3A 0000* C DAPROC: LD A,(LSTCU) ;CHECK OFFSET CHANNEL
370 0291 E6 0F C AND 0FH
371 0293 FE 0F C CP 0FH
372 0295 CA 03CB C JP Z,OFFSET ;TO SAVE OFFSET DATA
373 0298 3A 0000* C LD A,(LSTCU) ;LOAD OFFSET DATA
374 029B F6 0F C OR 0FH
375 029D 21 0000* C LD HL,DATA
376 02A0 16 00 C LD D,00H
377 02A2 5F C LD E,A
378 02A3 CB 23 C SLA E
379 02A5 CB 12 C RL D
380 02A7 19 C ADD HL,DE
381 02A8 5E C LD E,(HL) ;CURRENT OFFSET DATA AT DE
382 02A9 23 C INC HL
383 02AA 56 C LD D,(HL)
384 02AB 7E C LD A,(HL) ;CHECK OFFSET SIGN
385 02AC E6 20 C AND 20H
386 02AE 47 C LD B,A ;SAVE IN B
387 02AF 3A 0000* C LD A,(ADDAT) ;LOAD DATA READ FROM A/D
388 02B2 6F C LD L,A
389 02B3 3A 0001* C LD A,(ADDAT+1)
390 02B6 67 C LD H,A
391 02B7 CB 67 C BIT 4,A ;CHECK OVER RANGE
392 02B9 C2 03D7 C JP NZ,OVER

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393	02BC	E6 20	C	AND	20H	
394	02BE	88	C	CP	B	;CHECK ADD OR SUBTRACT OFFSET
395	02BF	20 26	C	JR	NZ,ADDS	;TO ADD OFFSET IF DIFFERENCE SIGN
396	02C1	7C	C	LD	A,H	;SUBTRACT IF SAME SIGN
397	02C2	E6 2F	C	AND	2FH	
398	02C4	67	C	LD	H,A	
399	02C5	47	C	LD	B,A	;SAVE SIGN DATA
400	02C6	37	C	SCF		
401	02C7	3F	C	CCF		
402	02C8	ED 52	C	SBC	HL,DE	
403	02CA	30 13	C	JR	NC,SAMSN	;OFFSET < DATA TO SAME SIGN
404	02CC	11 0000	C	LD	DE,0000H	;COMPLEMENT
405	02CF	EB	C	EX	DE,HL	
406	02D0	37	C	SCF		
407	02D1	3F	C	CCF		
408	02D2	ED 52	C	SBC	HL,DE	
409	02D4	CB 68	C	BIT	5,B	;CHANGE SIGN
410	02D6	20 02	C	JR	NZ,PASS6	
411	02D8	CB EC	C	SET	5,H	
412	02DA	CD 03E7	C PASS6:	CALL	RAGLIN	
413	02DD	18 13	C	JR	BITBD	
414	02DF	CB 68	C SAMSN:	BIT	5,B	;SAME SIGN
415	02E1	28 F7	C	JR	Z,PASS6	
416	02E3	CB EC	C	SET	5,H	
417	02E5	18 F3	C	JR	PASS6	
418	02E7	7C	C ADDS:	LD	A,H	;ADD OFFSET
419	02E8	E6 2F	C	AND	2FH	
420	02EA	67	C	LD	H,A	
421	02EB	7A	C	LD	A,D	;SIGN FOLLOW DATA
422	02EC	E6 0F	C	AND	0FH	
423	02EE	57	C	LD	D,A	
424	02EF	19	C	ADD	HL,DE	
425	02F0	18 EB	C	JR	PASS6	
426	02F2	E5	C BITBD:	PUSH	HL	;CHANGE TO BCD
427	02F3	EB	C	EX	DE,HL	
428	02F4	7A	C	LD	A,D	
429	02F5	E6 0F	C	AND	0FH	
430	02F7	57	C	LD	D,A	
431	02F8	CB 43	C	BIT	0,E	
432	02FA	28 01	C	JR	Z,SHIFT	;INCREMENT IF LAST BIT = 1
433	02FC	13	C	INC	DE	
434	02FD	CB 3A	C SHIFT:	SRL	D	;SHIFT 1 BIT
435	02FF	CB 1B	C	RR	E	
436	0301	4A	C	LD	C,D	;FIND HIGH BYTE BCD VALUE
437	0302	CB 21	C	SLA	C	
438	0304	06 00	C	LD	B,00H	
439	0306	21 0000*	C	LD	HL,HUNDAT##	;TABLE AT HUNDAT
440	0309	09	C	ADD	HL,BC	
441	030A	4E	C	LD	C,(HL)	;HIGH BYTE BCD VALUE SAVE IN BC
442	030B	23	C	INC	HL	
443	030C	46	C	LD	B,(HL)	
444	030D	7B	C	LD	A,E	;FIND LOW BYTE BCD DATA
445	030E	16 64	C	LD	D,64H	;100 BCD = 64 HEX
446	0310	82	C	ADD	A,D	
447	0311	1E FF	C	LD	E,OFFH	;HUNDATE DIGIT IN E
448	0313	92	C NTLOP:	SUB	D	;DEVIDE BY SUBTRACT

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449	0314	1C	C	INC	E	
450	0315	BA	C	CP	D	
451	0316	30 FB	C	JR	NC,NTLOP	
452	0318	16 0A	C	LD	D,0AH	;10 BCD = 0A HEX
453	031A	82	C	ADD	A,D	
454	031B	2E FF	C	LD	L,OFFH	;TEN DIGIT IN L
455	031D	92	C NLOP:	SUB	D	;DEVIDE BY SUBTRACT
456	031E	2C	C	INC	L	
457	031F	BA	C	CP	D	
458	0320	30 FB	C	JR	NC,NLOP	
459	0322	CB 25	C	SLA	L	;SHIFT TEN DIGIT
460	0324	CB 25	C	SLA	L	
461	0326	CB 25	C	SLA	L	
462	0328	CB 25	C	SLA	L	
463	032A	B5	C	OR	L	;TEN DIGIT AND FIRST DIGIT AT A
464	032B	81	C	ADD	A,C	;ADD HIGH AND LOW BYTE OF TEN AND FIRST DIGIT
465	032C	27	C	DAA		
466	032D	6F	C	LD	L,A	;SAVE IN L
467	032E	7B	C	LD	A,E	;ADD HIGH AND LOW BYTE OF HUNDATE DIGIT
468	032F	88	C	ADC	A,B	
469	0330	27	C	DAA		
470	0331	67	C	LD	H,A	;SAVE IN H
471	0332	D1	C	POP	DE	;CHECK SIGN
472	0333	CB 6C	C	BIT	5,H	;CHECK OVER 1999
473	0335	C2 03D7	C	JP	NZ,OVER	
474	0338	CB 6A	C	BIT	5,D	
475	033A	20 02	C	JR	NZ,HALM	;POSITIVE
476	033C	CB EC	C	SET	5,H	
477	033E	E5	C HALM:	PUSH	HL	;COMPARE HIGH LIMIT
478	033F	21 0000*	C	LD	HL,HLMT	
479	0342	01 0000*	C	LD	BC,LSTCU	
480	0345	CD 0000*	C	CALL	CURADD##	
481	0348	5E	C	LD	E,(HL)	;HIGH LIMIT TO DE
482	0349	23	C	INC	HL	
483	034A	56	C	LD	D,(HL)	
484	034B	E1	C	POP	HL	
485	034C	CB 6C	C	BIT	5,H	;CHECK DATA SIGN
486	034E	20 12	C	JR	NZ,NEGSGN	;TO NEGATIVE SIGN
487	0350	CB 6A	C	BIT	5,D	;CHECK HIGH LIMIT SIGN
488	0352	20 1E	C	JR	NZ,HIGHL	;TO OVER HIGH LIMIT
489	0354	7A	C	LD	A,D	
490	0355	E6 1F	C	AND	1FH	
491	0357	BC	C	CP	H	;COMPARE HIGH BYTE
492	0358	38 18	C	JR	C,HIGHL	
493	035A	20 1C	C	JR	NZ,LALM	;TO CHECK LOW LIMIT
494	035C	7B	C	LD	A,E	
495	035D	BD	C	CP	L	;COMPARE LOW BYTE
496	035E	38 12	C	JR	C,HIGHL	
497	0360	18 16	C	JR	LALM	
498	0362	CB 6A	C NEGSGN:	BIT	5,D	
499	0364	28 12	C	JR	Z,LALM	
500	0366	7A	C	LD	A,D	
501	0367	E6 3F	C	AND	3FH	
502	0369	BC	C	CP	H	
503	036A	38 0C	C	JR	C,LALM	
504	036C	20 04	C	JR	NZ,HIGHL	

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505 036E 7B C LD A,E
506 036F BD C CP L
507 0370 38 06 C JR C,LALM
508 0372 CB FC C HIGHL: SET 7,H ;SET ALARM CODE
509 0374 3E 0B C LD A,0BH ;OUT ALARM
510 0376 D3 00* C OUT (PORTC2##),A
511 0378 E5 C LALM: PUSH HL ;COMPARE LOW LIMIT
512 0379 21 0000* C LD HL,LLIMIT
513 037C 01 0000* C LD BC,LSTCU
514 037F CD 0000* C CALL CURADD##
515 0382 5E C LD E,(HL) ;LOW LIMIT TO DE
516 0383 23 C INC HL
517 0384 56 C LD D,(HL)
518 0385 E1 C POP HL
519 0386 CB 6C C BIT 5,H ;CHECK DATA SIGN
520 0388 28 16 C JR Z,POSSGN ;TO POSITIVE SIGN
521 038A CB 6A C BIT 5,D ;CHECK LOW LIMIT SIGN
522 038C 28 26 C JR Z,LOWL ;TO UNDER LOW LIMIT
523 038E 7C C LD A,H
524 038F E6 3F C AND 3FH
525 0391 47 C LD B,A
526 0392 7A C LD A,D
527 0393 E6 3F C AND 3FH
528 0395 B8 C CP B ;COMPARE HIGH BYTE
529 0396 38 1C C JR C,LOWL
530 0398 20 20 C JR NZ,SAVE ;TO SAVE DATA
531 039A 7B C LD A,E
532 039B BD C CP L ;COMPARE LOW BYTE
533 039C 38 16 C JR C,LOWL
534 039E 18 1A C JR SAVE
535 03A0 CB 6A C POSSGN: BIT 5,D
536 03A2 20 16 C JR NZ,SAVE
537 03A4 7C C LD A,H
538 03A5 E6 3F C AND 3FH
539 03A7 47 C LD B,A
540 03A8 7A C LD A,D
541 03A9 E6 1F C AND 1FH
542 03AB B8 C CP B
543 03AC 38 0C C JR C,SAVE
544 03AE 20 04 C JR NZ,LOWL
545 03B0 7B C LD A,E
546 03B1 BD C CP L
547 03B2 38 06 C JR C,SAVE
548 03B4 CB F4 C LOWL: SET 6,H ;SET ALARM CODE
549 03B6 3E 0D C LD A,0DH ;OUT ALARM
550 03B8 D3 00* C OUT (PORTC2##),A
551 03BA E5 C SAVE: PUSH HL ;SAVE DATA
552 03BB 21 0000* C LD HL,DATA
553 03BE 01 0000* C LD BC,LSTCU
554 03C1 CD 0000* C CALL CURADD##
555 03C4 EB C EX DE,HL
556 03C5 E1 C POP HL
557 03C6 EB C EX DE,HL
558 03C7 73 C LD (HL),E
559 03C8 23 C INC HL
560 03C9 72 C LD (HL),D

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561 03CA C9 C RET
562 03CB 3A 0000* C OFFSET: LD A,(ADDAT) ;SAVE OFFSET DATA
563 03CE 6F C LD L,A
564 03CF 3A 0001* C LD A,(ADDAT+1)
565 03D2 E6 2F C AND 2FH ;MARK USE BIT
566 03D4 67 C LD H,A
567 03D5 18 E3 C JR SAVE
568 03D7 3E 09 C OVER: LD A,09H ;OUT ALARM
569 03D9 D3 00* C OUT (PORTC2##),A
570 03DB 2E AA C LD L,0AAH ;SAVE FFF DATA
571 03DD 7C C LD A,H
572 03DE E6 20 C AND 20H
573 03E0 F6 1A C OR 1AH
574 03E2 EE 20 C XOR 20H
575 03E4 67 C LD H,A
576 03E5 18 D3 C JR SAVE
577 C INCLUDE B:RAGLIN
578 C
579 C ;*****
580 C ;* RANGE LINEARLIZATION *
581 C ;*****
582 C ;FIND RANGE OF READ CHANNEL AND JUMP TO LINEARLIZE PROGRAM
583 C ;
584 03E7 E5 C RAGLIN: PUSH HL ;FIND RANGE FOR LINEARLIZE
585 03E8 01 0000* C LD BC,LSTCU
586 03EB CD 0000* C CALL CURRAG##
587 03EE 7E C LD A,(HL)
588 03EF E6 0F C AND 0FH
589 03F1 CB 27 C SLA A
590 03F3 21 05AC C LD HL,RAGSEN
591 03F6 16 00 C LD D,00H
592 03F8 5F C LD E,A
593 03F9 19 C ADD HL,DE
594 03FA 5E C LD E,(HL)
595 03FB 23 C INC HL
596 03FC 56 C LD D,(HL)
597 03FD EB C EX DE,HL
598 03FE E9 C JP (HL)
599 03FF E1 C RANGE0: POP HL ;NOT USE
600 0400 C9 C RET
601 0401 E1 C RANGE1: POP HL ;1.999 mV
602 0402 C9 C RET
603 0403 E1 C RANGE2: POP HL ;19.99 mV
604 0404 C9 C RET
605 0405 E1 C RANGE3: POP HL ;199.9 mV
606 0406 C9 C RET
607 0407 E1 C RANGE4: POP HL ;1999 mV
608 0408 C9 C RET
609 0409 E1 C RANGE5: POP HL ;19.99 V
610 040A C9 C RET
611 040B E1 C RANGE6: POP HL ;19.99 mA
612 040C C9 C RET
613 040D E1 C RANGE7: POP HL ;199.9 mA
614 040E C9 C RET
615 040F E1 C RANGE8: POP HL ;1999 C THERMOCOUPLE SENSOR
616 0410 C9 C RET

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617	0411	FD 21 0C7F	C RANGE9:	LD	IY,THCP1+1	;199.9 C THERMOCOUPLE SENSOR
618	0415	DD 21 0DF2	C	LD	IX,CDJC1+1	;COLD JUNCTION COMPENSATION
619	0419	D1	C	POP	DE	
620	041A	CD 0515	C	CALL	CDCOMP	
621	041D	CD 0434	C	CALL	LINEAR	
622	0420	C9	C	RET		
623	0421	E1	C RANGE10:	POP	HL	;1999 F THERMOCOUPLE SENSOR
624	0422	C9	C	RET		
625	0423	E1	C RANGE11:	POP	HL	;199.9 F THERMOCOUPLE SENSOR
626	0424	C9	C	RET		
627	0425	FD 21 0D75	C RANGE12:	LD	IY,RESB1+1	;199.9 C RESISTANCE BULB PT 100 SENSOR
628	0429	D1	C	POP	DE	
629	042A	CD 0434	C	CALL	LINEAR	
630	042D	C9	C	RET		
631	042E	E1	C RANGE13:	POP	HL	;199.9 F RESISTANCE BULB PT 100 SENSOR
632	042F	C9	C	RET		
633	0430	E1	C RANGE14:	POP	HL	;199.9 C THERMISTOR SENSOR
634	0431	C9	C	RET		
635	0432	E1	C RANGE15:	POP	HL	;199.9 F THERMISTOR SENSOR
636	0433	C9	C	RET		
637	0434	CB 6A	C LINEAR:	BIT	5,D	;PIECEWISE LINEARLIZE
638	0436	20 5C	C	JR	NZ,POSDAT	;TO POSITIVE DATA
639	0438	CD 04EB	C	CALL	COMPLE	;COMPLEMENT
640	043B	CD 0507	C	CALL	TENMUL	;MULTIPLY BY TEN
641	043E	EB	C	EX	DE,HL	
642	043F	FD E5	C	PUSH	IY	
643	0441	E1	C	POP	HL	
644	0442	AF	C	XOR	A	
645	0443	BA	C	CP	D	
646	0444	20 05	C	JR	NZ,NXTCP	
647	0446	BB	C	CP	E	
648	0447	20 02	C	JR	NZ,NXTCP	
649	0449	EB	C	EX	DE,HL	
650	044A	C9	C	RET		
651	044B	7E	C NXTCP:	LD	A,(HL)	
652	044C	BA	C	CP	D	
653	044D	38 10	C	JR	C,CALDT	;TO CALCULATE DATA
654	044F	28 08	C	JR	Z,CPLow	;TO COMARE LOW BYTE DATA
655	0451	2B	C	DEC	HL	
656	0452	2B	C NXTCP1:	DEC	HL	
657	0453	2B	C	DEC	HL	
658	0454	2B	C	DEC	HL	
659	0455	2B	C	DEC	HL	
660	0456	2B	C	DEC	HL	
661	0457	18 F2	C	JR	NXTCP	
662	0459	2B	C CPLow:	DEC	HL	
663	045A	7E	C	LD	A,(HL)	
664	045B	BB	C	CP	E	
665	045C	30 F4	C	JR	NC,NXTCP1	
666	045E	23	C	INC	HL	
667	045F	2B	C CALDT:	DEC	HL	
668	0460	2B	C	DEC	HL	
669	0461	CD 04F3	C	CALL	ADDY	;ADD Y AXIS
670	0464	E5	C	PUSH	HL	
671	0465	C1	C	POP	BC	
672	0466	CD 04EB	C	CALL	COMPLE	;COMPLEMENT

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673	0469	0B	C	DEC	BC	
674	046A	0A	C	LD	A,(BC)	
675	046B	57	C	LD	D,A	
676	046C	0B	C	DEC	BC	
677	046D	0A	C	LD	A,(BC)	
678	046E	5F	C	LD	E,A	
679	046F	CD 04FA	C	CALL	DIVIDE	;DIVIDE BY SUBTRACT
680	0472	C5	C	PUSH	BC	
681	0473	CD 0507	C	CALL	TENMUL	;MULTIPLY BY TEN
682	0476	CD 04FA	C	CALL	DIVIDE	
683	0479	C5	C	PUSH	BC	
684	047A	CD 0507	C	CALL	TENMUL	
685	047D	CD 04FA	C	CALL	DIVIDE	
686	0480	CD 050E	C	CALL	CKREM	;CHECK REMAIN
687	0483	C5	C	PUSH	BC	
688	0484	D1	C	POP	DE	
689	0485	E1	C	POP	HL	
690	0486	CD 0507	C	CALL	TENMUL	
691	0489	19	C	ADD	HL,DE	
692	048A	EB	C	EX	DE,HL	
693	048B	E1	C	POP	HL	
694	048C	CD 0507	C	CALL	TENMUL	
695	048F	CD 0507	C	CALL	TENMUL	
696	0492	19	C	ADD	HL,DE	
697	0493	C9	C	RET		
698	0494	CB AA	C	POS DAT:	RES	5,D
699	0496	EB	C	EX	DE,HL	
700	0497	CD 0507	C	CALL	TENMUL	
701	049A	EB	C	EX	DE,HL	
702	049B	FD E5	C	PUSH	IY	
703	049D	E1	C	POP	HL	
704	049E	23	C	INC	HL	
705	049F	23	C	INC	HL	
706	04A0	23	C	INC	HL	
707	04A1	23	C	INC	HL	
708	04A2	23	C	INC	HL	
709	04A3	23	C	INC	HL	
710	04A4	7E	C	NXTCP2:	LD	A,(HL)
711	04A5	BA	C	CP	D	
712	04A6	30 0B	C	JR	NC,CLOW1	
713	04A8	23	C	NXTCP3:	INC	HL
714	04A9	23	C	INC	HL	
715	04AA	23	C	INC	HL	
716	04AB	23	C	INC	HL	
717	04AC	23	C	INC	HL	
718	04AD	23	C	INC	HL	
719	04AE	18 F4	C	JR	NXTCP2	
720	04B0	20 06	C	CLOW1:	JR	NZ,CALDT1
721	04B2	2B	C	DEC	HL	
722	04B3	7E	C	LD	A,(HL)	
723	04B4	23	C	INC	HL	
724	04B5	BB	C	CP	E	
725	04B6	38 F0	C	JR	C,NXTCP3	
726	04B8	2B	C	CALDT1:	DEC	HL
727	04B9	2B	C	DEC	HL	
728	04BA	CD 04F3	C	CALL	ADDY	

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729	04BD	2B	C	DEC	HL	
730	04BE	46	C	LD	B, (HL)	
731	04BF	2B	C	DEC	HL	
732	04C0	4E	C	LD	C, (HL)	
733	04C1	EB	C	EX	DE, HL	
734	04C2	C5	C	PUSH	BC	
735	04C3	D1	C	POP	DE	
736	04C4	CD 04FA	C	CALL	DIVIDE	
737	04C7	C5	C	PUSH	BC	
738	04C8	CD 0507	C	CALL	TENMUL	
739	04CB	CD 04FA	C	CALL	DIVIDE	
740	04CE	C5	C	PUSH	BC	
741	04CF	CD 0507	C	CALL	TENMUL	
742	04D2	CD 04FA	C	CALL	DIVIDE	
743	04D5	CD 050E	C	CALL	CKREM	
744	04D8	C5	C	PUSH	BC	
745	04D9	D1	C	POP	DE	
746	04DA	E1	C	POP	HL	
747	04DB	CD 0507	C	CALL	TENMUL	
748	04DE	19	C	ADD	HL, DE	
749	04DF	EB	C	EX	DE, HL	
750	04E0	E1	C	POP	HL	
751	04E1	CD 0507	C	CALL	TENMUL	
752	04E4	CD 0507	C	CALL	TENMUL	
753	04E7	19	C	ADD	HL, DE	
754	04E8	CB EC	C	SET	5, H	
755	04EA	C9	C	RET		
756	04EB	21 0000	C	COMPLE: LD	HL, 0000H	; COMPLEMENT
757	04EE	37	C	SCF		
758	04EF	3F	C	CCF		
759	04F0	ED 52	C	SBC	HL, DE	
760	04F2	C9	C	RET		
761	04F3	46	C	ADDY: LD	B, (HL)	; ADD Y AXIS DATA
762	04F4	2B	C	DEC	HL	
763	04F5	4E	C	LD	C, (HL)	
764	04F6	EB	C	EX	DE, HL	
765	04F7	09	C	ADD	HL, BC	
766	04F8	EB	C	EX	DE, HL	
767	04F9	C9	C	RET		
768	04FA	01 0000	C	DIVIDE: LD	BC, 0000H	; DIVIDE BY SUBTRACT
769	04FD	03	C	NTSUB2: INC	BC	
770	04FE	37	C	SCF		
771	04FF	3F	C	CCF		
772	0500	ED 52	C	SBC	HL, DE	
773	0502	30 F9	C	JR	NC, NTSUB2	
774	0504	0B	C	DEC	BC	
775	0505	19	C	ADD	HL, DE	
776	0506	C9	C	RET		
777	0507	29	C	TENMUL: ADD	HL, HL	
778	0508	E5	C	PUSH	HL	
779	0509	C1	C	POP	BC	
780	050A	29	C	ADD	HL, HL	
781	050B	29	C	ADD	HL, HL	
782	050C	09	C	ADD	HL, BC	
783	050D	C9	C	RET		
784	050E	CB 3B	C	CKREM: SRL	E	

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785	0510	7D	C	LD	A,L
786	0511	BB	C	CP	E
787	0512	D8	C	RET	C
788	0513	03	C	INC	BC
789	0514	C9	C	RET	
790	0515	D5	C CDCOMP:	PUSH	DE
791	0516	21 01FC*	C	LD	HL,DATA+508
792	0519	5E	C	LD	E,(HL)
793	051A	23	C	INC	HL
794	051B	56	C	LD	D,(HL)
795	051C	01 0064	C	LD	BC,0064H
796	051F	21 0000	C	LD	HL,0000H
797	0522	7A	C	LD	A,D
798	0523	E6 0F	C	AND	0FH
799	0525	CB 62	C	BIT	4,D
800	0527	28 02	C	JR	Z,PASSB
801	0529	C6 0A	C	ADD	A,0AH
802	052B	FE 00	C PASSB:	CP	00H
803	052D	28 04	C	JR	Z,PASS9
804	052F	09	C ADD1:	ADD	HL,BC
805	0530	3D	C	DEC	A
806	0531	20 FC	C	JR	NZ,ADD1
807	0533	43	C PASS9:	LD	B,E
808	0534	CB 38	C	SRL	B
809	0536	CB 38	C	SRL	B
810	0538	CB 38	C	SRL	B
811	053A	CB 38	C	SRL	B
812	053C	04	C	INC	B
813	053D	0E 0A	C	LD	C,0AH
814	053F	AF	C	XOR	A
815	0540	91	C	SUB	C
816	0541	81	C ADD2:	ADD	A,C
817	0542	10 FD	C	DJNZ	ADD2
818	0544	4F	C	LD	C,A
819	0545	7B	C	LD	A,E
820	0546	E6 0F	C	AND	0FH
821	0548	81	C	ADD	A,C
822	0549	4F	C	LD	C,A
823	054A	06 00	C	LD	B,00H
824	054C	09	C	ADD	HL,BC
825	054D	EB	C	EX	DE,HL
826	054E	DD E5	C	PUSH	IX
827	0550	E1	C	POP	HL
828	0551	7E	C NXTCP4:	LD	A,(HL)
829	0552	8A	C	CP	D
830	0553	30 07	C	JR	NC,CLOW2
831	0555	23	C NXTCP5:	INC	HL
832	0556	23	C	INC	HL
833	0557	23	C	INC	HL
834	0558	23	C	INC	HL
835	0559	23	C	INC	HL
836	055A	18 F5	C	JR	NXTCP4
837	055C	20 06	C CLOW2:	JR	NZ,CALDT2
838	055E	2B	C	DEC	HL
839	055F	7E	C	LD	A,(HL)
840	0560	23	C	INC	HL

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841	0561	BB	C	CP	E	
842	0562	38 F1	C	JR	C,NXTCPS	
843	0564	2B	C CALDT2:	DEC	HL	
844	0565	2B	C	DEC	HL	
845	0566	7E	C	LD	A,(HL)	
846	0567	EB	C	EX	DE,HL	
847	0568	E5	C	PUSH	HL	
848	0569	C1	C	POP	BC	
849	056A	21 0000	C	LD	HL,0000H	
850	056D	09	C NADD:	ADD	HL,BC	
851	056E	3D	C	DEC	A	
852	056F	20 FC	C	JR	NZ,NADD	
853	0571	EB	C	EX	DE,HL	
854	0572	2B	C	DEC	HL	
855	0573	CD 04F3	C	CALL	ADDY	
856	0576	CB 3A	C	SRL	D	
857	0578	CB 1B	C	RR	E	
858	057A	CB 3A	C	SRL	D	
859	057C	CB 1B	C	RR	E	
860	057E	CB 3A	C	SRL	D	
861	0580	CB 1B	C	RR	E	
862	0582	CB 3A	C	SRL	D	
863	0584	CB 1B	C	RR	E	
864	0586	CB 3A	C	SRL	D	
865	0588	CB 1B	C	RR	E	
866	058A	CB 3A	C	SRL	D	
867	058C	CB 1B	C	RR	E	
868	058E	EB	C	EX	DE,HL	
869	058F	D1	C	POP	DE	
870	0590	CB 6A	C	BIT	5,D	
871	0592	20 15	C	JR	NZ,ADDCD	; TO ADD COLD JUNCTION
872	0594	EB	C	EX	DE,HL	
873	0595	37	C	SCF		
874	0596	3F	C	CCF		
875	0597	ED 52	C	SBC	HL,DE	
876	0599	38 02	C	JR	C,CHGSN	
877	059B	EB	C	EX	DE,HL	
878	059C	C9	C	RET		
879	059D	11 0000	C CHGSN:	LD	DE,0000H	
880	05A0	EB	C	EX	DE,HL	
881	05A1	37	C	SCF		
882	05A2	3F	C	CCF		
883	05A3	ED 52	C	SBC	HL,DE	
884	05A5	EB	C	EX	DE,HL	
885	05A6	CB EA	C	SET	5,D	
886	05A8	C9	C	RET		
887	05A9	19	C ADDCD:	ADD	HL,DE	
888	05AA	EB	C	EX	DE,HL	
889	05AB	C9	C	RET		
890	05AC	03FF	C RAGSEN:	DEFW	RANGE0	; RANGE SENSOR LINEARLIZE
891	05AE	0401	C	DEFW	RANGE1	
892	05B0	0403	C	DEFW	RANGE2	
893	05B2	0405	C	DEFW	RANGE3	
894	05B4	0407	C	DEFW	RANGE4	
895	05B6	0409	C	DEFW	RANGE5	
896	05B8	040B	C	DEFW	RANGE6	

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897 05BA 040D C DEFW RANGE7
898 05BC 040F C DEFW RANGE8
899 05BE 0411 C DEFW RANGE9
900 05C0 0421 C DEFW RANGE10
901 05C2 0423 C DEFW RANGE11
902 05C4 0425 C DEFW RANGE12
903 05C6 042E C DEFW RANGE13
904 05C8 0430 C DEFW RANGE14
905 05CA 0432 C DEFW RANGE15
906 C INCLUDE B:PRMOTM
907 C ;*****
908 C ;* PRINT MODE AND TIME *
909 C ;*****
910 C ;PRINT MODE AND TIME IN ONE LINE WHEN CHANGE MODE
911 C ;SEND DATA TO PRINTER AND SERIAL SEND
912 C ;
913 05CC AF C PRMOTM: XOR A ;MARK SEND TO PRINTER
914 05CD 32 0000* C LD (SNDTYP),A
915 05D0 CD 05D7 C CALL SNDMD ;SEND MODE STRING
916 05D3 CD 060D C CALL SNDTM ;SEND TIME
917 05D6 C9 C RET
918 05D7 3E 01 C SNDMD: LD A,01H ;SET SEND CONTROL STATE
919 05D9 32 0000* C LD (CTRLS),A
920 05DC CD 0654 C CALL CLRBUF ;CLEAR BUFFER
921 05DF FD 21 0000* C LD IY,SNDBUF ;LOAD DATA TO SEND BUFFER
922 05E3 06 02 C LD B,02H ;SEND 2 BLANK
923 05E5 CD 065F C CALL BLANK
924 05E8 21 0AEC C LD HL,MODES ;MODE STRING AT MODES
925 05EB 01 0007 C LD BC,0007H ;"RUN ", "HOLD ", "PROGRAM"
926 05EE 3A 0000* C LD A,(OPFUNC) ;CHECK OPERATED MODE
927 05F1 CB 7F C BIT 7,A
928 05F3 28 06 C JR Z,TRANS ;PRINT"RUN"
929 05F5 09 C ADD HL,BC
930 05F6 CB 77 C BIT 6,A
931 05F8 28 01 C JR Z,TRANS ;PRINT"HOLD"
932 05FA 09 C ADD HL,BC
933 05FB 06 07 C TRANS: LD B,07H ;TRANSFER MODE STRING
934 05FD CD 064A C CALL FIXED
935 0600 06 0B C LD B,0BH
936 0602 CD 065F C CALL BLANK
937 0605 CD 0668 C CALL SEND ;SEND TO PRINTER
938 0608 AF C XOR A ;RESET SEND CONTROL STATE
939 0609 32 0000* C LD (CTRLS),A
940 060C C9 C RET
941 060D FD 21 0000* C SNDTM: LD IY,SNDBUF ;LOAD TIME TO SEND BUFFER
942 0611 06 06 C LD B,06H
943 0613 CD 065F C CALL BLANK
944 0616 21 0B0A C LD HL,TIMES ;TIME STRING AT TIMES
945 0619 06 06 C LD B,06H ;"TIME "
946 061B CD 064A C CALL FIXED
947 061E 21 0005* C LD HL,TIMED+5 ;HOURS DATA
948 0621 06 02 C LD B,02H
949 0623 CD 063E C CALL NASCII
950 0626 FD 36 00 C LD (IY+0),3AH ;SEND": "
951 0629 3A C
952 062A FD 23 C INC IY ;MINUT DATA

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953 062C 06 02 C LD B,02H
954 062E CD 063E C CALL NASCII
955 0631 06 02 C LD B,02H
956 0633 CD 065F C CALL BLANK
957 0636 FD 36 00 C LD (IY+0),0AH ;SEND "LF"
958 0639 0A C
959 063A CD 066B C CALL SEND ;SEND DATA FROM BUFFER TO PRINTER
960 063D C9 C RET
961 063E 7E C NASCII: LD A,(HL)
962 063F C6 30 C ADD A,30H
963 0641 FD 77 00 C LD (IY+0),A
964 0644 2B C DEC HL
965 0645 FD 23 C INC IY
966 0647 10 F5 C DJNZ NASCII
967 0649 C9 C RET
968 064A 7E C FIXED: LD A,(HL)
969 064B FD 77 00 C LD (IY+0),A
970 064E 23 C INC HL
971 064F FD 23 C INC IY
972 0651 10 F7 C DJNZ FIXED
973 0653 C9 C RET
974 0654 21 0000* C CLRBUF: LD HL,CTRLP ;SET CONTROL CODE
975 0657 AF C XOR A ;SEND NUL
976 0658 77 C LD (HL),A
977 0659 23 C INC HL
978 065A 77 C LD (HL),A
979 065B 23 C INC HL
980 065C 36 18 C LD (HL),18H ;CLEAR BUFFER
981 065E C9 C RET
982 065F FD 36 00 C BLANK: LD (IY+0),20H
983 0662 20 C
984 0663 FD 23 C INC IY
985 0665 10 FB C DJNZ BLANK
986 0667 C9 C RET
987 0668 3A 0000* C SEND: LD A,(SNDTYP) ;CHECK SERIAL SEND OR PRINTER
988 066B FE 00 C CP 00H
989 066D 20 35 C JR NZ,SERSND ;TO SERIAL SEND
990 066F 3A 0000* C LD A,(CTRLS) ;CHECK SEND CONTROL PRINT
991 0672 FE 01 C CP 01H
992 0674 20 0C C JR NZ,NOTCTRL ;NOT SEND CONTROL
993 0676 06 03 C LD B,03H ;CONTROL BUFFER 3 BYTE AT CTRLP
994 0678 21 0000* C LD HL,CTRLP
995 067B 56 C SNDAGN: LD D,(HL)
996 067C CD 0693 C CALL SNDPORT ;SEND TO 8255 PORT
997 067F 23 C INC HL
998 0680 10 F9 C DJNZ SNDAGN
999 0682 06 14 C NOTCTRL: LD B,14H ;BUFFER = 20 BYTE
1000 0684 FD 21 0000* C LD IY,SNDLBUF
1001 0688 FD 56 00 C SNDLOOP: LD D,(IY+0)
1002 068B CD 0693 C CALL SNDPORT
1003 068E FD 23 C INC IY
1004 0690 10 F6 C DJNZ SNDLOOP
1005 0692 C9 C RET
1006 0693 DB 00* C SNDPORT: IN A,(PORTC1##) ;CHECK BUSY
1007 0695 E6 20 C AND 20H
1008 0697 20 FA C JR NZ,SNDPORT

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1009 0699 7A C LD A,D
1010 069A D3 00* C OUT (PORTA1##),A ;OUT DATA
1011 069C AF C XOR A
1012 069D D3 00* C OUT (PORTB1##),A ;STROBE PULSE LOW
1013 069F CB FF C SET 7,A
1014 06A1 D3 00* C OUT (PORTB1##),A ;RESET HIGH
1015 06A3 C9 C RET
1016 06A4 01 1414 C SERSND: LD BC,1414H
1017 06A7 FD 21 0000* C LD IY,SNDBUF
1018 06AB FD 56 00 C SERAGN: LD D,(IY+0)
1019 06AE CD 06DE C CALL TX ;SEND TO 8251 PORT
1020 06B1 C5 C PUSH BC
1021 06B2 06 00* C LD B,SNLDY## ;DELAY TIME
1022 06B4 10 FE C DELAY2: DJNZ DELAY2
1023 06B6 C1 C POP BC
1024 06B7 78 C LD A,B ;CHECK FIRST XOR
1025 06B8 B9 C CP C
1026 06B9 28 20 C JR Z,NOTXOR
1027 06BB 7A C LD A,D
1028 06BC AB C XOR E
1029 06BD 5F C LD E,A
1030 06BE FD 23 C FTXOR: INC IY
1031 06C0 10 E9 C DJNZ SERAGN
1032 06C2 3A 0000* C LD A,(XORST) ;CHECK FIRST XOR GROUP
1033 06C5 FE 00 C CP 00H
1034 06C7 28 08 C JR Z,FTGXOR
1035 06C9 3A 0000* C LD A,(XORBUF) ;GROUP XOR
1036 06CC AB C XOR E
1037 06CD 32 0000* C LD (XORBUF),A
1038 06D0 C9 C RET
1039 06D1 7B C FTGXOR: LD A,E
1040 06D2 32 0000* C LD (XORBUF),A
1041 06D5 3E 01 C LD A,01H
1042 06D7 32 0000* C LD (XORST),A
1043 06DA C9 C RET
1044 06DB 5A C NOTXOR: LD E,D
1045 06DC 18 E0 C JR FTXOR
1046 06DE DB 00* C TX:: IN A,(CB251##) ;PORT CONTROL OF 8251
1047 06E0 CB 47 C BIT 0,A ;CHECK TXRDY
1048 06E2 28 FA C JR Z,TX
1049 06E4 7A C LD A,D
1050 06E5 D3 00* C OUT (DB251##),A ;PORT DATA OF 8251
1051 06E7 C9 C RET
1052 C INCLUDE B:HLDPRN
1053 C ;*****
1054 C ;* PRINT DATA IN HOLD AND RUN MODE *
1055 C ;*****
1056 C ;PRINT DATE, TIME, SET OF DATA, ABNORMAL DATA
1057 C ;
1058 06E8 AF C HLDPRN: XOR A ;MARK SEND TO PRINTER
1059 06E9 32 0000* C LD (SNDTYP),A
1060 06EC CD 0823 C SNEBDA: CALL SNDBNK ;SEND BLANK
1061 06EF CD 07DE C CALL SNDDATE ;SEND DATE
1062 06F2 CD 060D C CALL SNDDTM ;SEND TIME
1063 06F5 21 0B10 C LD HL,CHDAUN ;SEND FIXED FORMAT * CH NO. DATA UNIT *
1064 06F8 CD 0834 C CALL SNDFIX

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1065	06FB	21 0B10	C	LD	HL,CHDAUN	
1066	06FE	CD 0B34	C	CALL	SNDFIX	
1067	0701	CD 0705	C	CALL	SNDDATA	;SEND SET OF DATA
1068	0704	C9	C	RET		
1069	0705	3E FF	C	SNDDATA: LD	A,OFFH	;START AT CHANNEL 00H
1070	0707	32 0000*	C	LD	(CHNSND),A	
1071	070A	21 0000*	C	NTCHN: LD	HL,CHNSND	
1072	070D	34	C	INC	(HL)	;INCREMENT CHANNEL
1073	070E	3E FF	C	LD	A,OFFH	;STOP AT CHANNEL OFFH
1074	0710	BE	C	CP	(HL)	
1075	0711	2B 0A	C	JR	Z,SNDBN	;TO SEND ABNORMAL DATA
1076	0713	CD 0000*	C	CALL	CKUSE##	;CHECK USE CHANNEL
1077	0716	20 F2	C	JR	NZ,NTCHN	;NOT USE TO NEXT CHANNEL
1078	0718	CD 0B4D	C	CALL	SNDCDU	;SEND CURRENT CHANNEL DATA
1079	071B	1B ED	C	JR	NTCHN	;TO CHECK NEXT CHANNEL
1080	071D	CD 0B23	C	SNDBN: CALL	SNDBNK	
1081	0720	3E 01	C	LD	A,01H	;SET SEND CONTROL STATE
1082	0722	32 0000*	C	LD	(CTRLS),A	
1083	0725	CD 0B41	C	CALL	LFRED	;SEND LINE FEED AND RED PRINT
1084	0728	21 0B24	C	LD	HL,UNLOW	;SEND FIXED FORMAT " * UNDER LOW LIMIT,LF"
1085	072B	CD 0B34	C	CALL	SNDFIX	
1086	072E	AF	C	XOR	A	
1087	072F	32 0000*	C	LD	(CTRLS),A	;RESET SEND CONTROL STATE
1088	0732	32 0000*	C	LD	(FOUND),A	;SET FOUND ABNORMAL DATA STATE
1089	0735	3E FF	C	LD	A,OFFH	;START AT CHANNEL 00H
1090	0737	32 0000*	C	LD	(CHNSND),A	
1091	073A	CD 07BA	C	NXTCHN: CALL	ABCHN	;CHECK ABNORMAL DATA
1092	073D	2B 0E	C	JR	Z,CCKFND	
1093	073F	23	C	INC	HL	
1094	0740	CB 76	C	BIT	6,(HL)	
1095	0742	2B F6	C	JR	Z,NXTCHN	;NOT FOUND TO NEXT CHANNEL
1096	0744	21 0000*	C	LD	HL,FOUND	;SET FOUND STATE
1097	0747	34	C	INC	(HL)	
1098	0748	CD 0B4D	C	CALL	SNDCDU	;SEND CHANNEL ERROR DATA
1099	074B	1B ED	C	JR	NXTCHN	
1100	074D	CD 07D1	C	CCKFND: CALL	CKFND	;CHECK FOUND DATA
1101	0750	CD 0B23	C	CALL	SNDBNK	
1102	0753	3E 01	C	LD	A,01H	
1103	0755	32 0000*	C	LD	(CTRLS),A	
1104	0758	CD 0B41	C	CALL	LFRED	
1105	075B	21 0B3B	C	LD	HL,DVHIGH	;SEND FIXED FORMAT " * OVER HIGH LIMIT,LF"
1106	075E	CD 0B34	C	CALL	SNDFIX	
1107	0761	AF	C	XOR	A	
1108	0762	32 0000*	C	LD	(CTRLS),A	
1109	0765	32 0000*	C	LD	(FOUND),A	
1110	0768	3E FF	C	LD	A,OFFH	
1111	076A	32 0000*	C	LD	(CHNSND),A	
1112	076D	CD 07BA	C	NTCH: CALL	ABCHN	
1113	0770	2B 0E	C	JR	Z,CHKFND	
1114	0772	23	C	INC	HL	
1115	0773	CB 7E	C	BIT	7,(HL)	
1116	0775	2B F6	C	JR	Z,NTCH	
1117	0777	21 0000*	C	LD	HL,FOUND	
1118	077A	34	C	INC	(HL)	
1119	077B	CD 0B4D	C	CALL	SNDCDU	
1120	077E	1B ED	C	JR	NTCH	

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1121	0780	CD 07D1	C	CHKFND:	CALL	CKFND		
1122	0783	CD 0823	C		CALL	SNDBNK		
1123	0786	3E 01	C		LD	A,01H		
1124	0788	32 0000*	C		LD	(CTRLS),A		
1125	078B	CD 0841	C		CALL	LFRED		
1126	078E	21 084C	C		LD	HL,DVRNGE	;SEND FIXED FORMAT " * OVER RANGE	,LF"
1127	0791	CD 0834	C		CALL	SNDFIX		
1128	0794	AF	C		XOR	A		
1129	0795	32 0000*	C		LD	(CTRLS),A		
1130	0798	32 0000*	C		LD	(FOUND),A		
1131	079B	3E FF	C		LD	A,OFFH		
1132	079D	32 0000*	C		LD	(CHNSND),A		
1133	07A0	CD 07BA	C	NEXTCH:	CALL	ABCHN		
1134	07A3	2B 0E	C		JR	Z,CKFOND		
1135	07A5	3E AA	C		LD	A,0AAH		
1136	07A7	BE	C		CP	(HL)		
1137	07A8	20 F6	C		JR	NZ,NEXTCH		
1138	07AA	21 0000*	C		LD	HL,FOUND		
1139	07AD	34	C		INC	(HL)		
1140	07AE	CD 084D	C		CALL	SNDCDU		
1141	07B1	18 ED	C		JR	NEXTCH		
1142	07B3	CD 07D1	C	CKFOND:	CALL	CKFND		
1143	07B6	CD 0823	C		CALL	SNDBNK		
1144	07B9	C9	C		RET			
1145	07BA	21 0000*	C	ABCHN:	LD	HL,CHNSND	;FIND ABNORMAL CHANNEL	
1146	07BD	34	C		INC	(HL)		
1147	07BE	3E FF	C		LD	A,OFFH		
1148	07C0	BE	C		CP	(HL)		
1149	07C1	C8	C		RET	Z		
1150	07C2	CD 0000*	C		CALL	CKUSE##		
1151	07C5	20 F3	C		JR	NZ,ABCHN		
1152	07C7	21 0000*	C		LD	HL,DATA		
1153	07CA	01 0000*	C		LD	BC,CHNSND		
1154	07CD	CD 0000*	C		CALL	CURADD##		
1155	07D0	C9	C		RET			
1156	07D1	3A 0000*	C	CKFND:	LD	A,(FOUND)	;CHECK FOUND STATE	
1157	07D4	FE 00	C		CP	00H		
1158	07D6	C0	C		RET	NZ		
1159	07D7	21 0860	C		LD	HL,NOTFD	; " NOT FOUND	,LF"
1160	07DA	CD 0834	C		CALL	SNDFIX		
1161	07DD	C9	C		RET			
1162	07DE	3E 01	C	SNDDATE:	LD	A,01H	;SET SEND CONTROL STATE	
1163	07E0	32 0000*	C		LD	(CTRLS),A		
1164	07E3	CD 0654	C		CALL	CLRBUF	;CLEAR BUFFER	
1165	07E6	FD 21 0000*	C		LD	IY,SNDBUF	;LOAD DATA TO SEND BUFFER	
1166	07EA	21 0801	C		LD	HL,DATES	;DATE STRING AT DATES	
1167	07ED	06 09	C		LD	B,09H	; " DATE "	
1168	07EF	CD 064A	C		CALL	FIXED		
1169	07F2	21 0007*	C		LD	HL,TIMED+7	;SEND DATE NUMBER	
1170	07F5	06 02	C		LD	B,02H	;2 BYTE	
1171	07F7	CD 063E	C		CALL	NASCII		
1172	07FA	1E 2D	C		LD	E,2DH	;SEND " - "	
1173	07FC	FD 73 00	C		LD	(IY+0),E		
1174	07FF	FD 23	C		INC	IY		
1175	0801	21 0009*	C		LD	HL,TIMED+9	;SEND MONTH NUMBER	
1176	0804	06 02	C		LD	B,02H		



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1177 0806 CD 063E C CALL NASCII
1178 0809 FD 73 00 C LD (IY+0),E
1179 080C FD 23 C INC IY
1180 080E 21 000B* C LD HL,TIMED+11 ;SEND YEAR NUMBER
1181 0811 06 02 C LD B,02H
1182 0813 CD 063E C CALL NASCII
1183 0816 06 03 C LD B,03H
1184 0818 CD 065F C CALL BLANK
1185 081B CD 0668 C CALL SEND
1186 081E AF C XOR A ;RESET SEND CNTRL STATE
1187 081F 32 0000* C LD (CTRLS),A
1188 0822 C9 C RET
1189 0823 FD 21 0000* C SNDBNK: LD IY,SNDBUF
1190 0827 06 13 C LD B,13H
1191 0829 CD 065F C CALL BLANK
1192 082C FD 36 00 C LD (IY+0),0AH ;LINE FEED
1193 082F 0A C
1194 0830 CD 0668 C CALL SEND
1195 0833 C9 C RET
1196 0834 FD 21 0000* C SNDFIX: LD IY,SNDBUF
1197 0838 06 14 C LD B,14H
1198 083A CD 064A C CALL FIXED
1199 083D CD 0668 C CALL SEND
1200 0840 C9 C RET
1201 0841 21 0000* C LFRED: LD HL,CTRLP ;SET CONTROL CODE
1202 0844 36 0A C LD (HL),0AH ;LINE FEED
1203 0846 23 C INC HL
1204 0847 36 18 C LD (HL),18H ;CLEAR BUFFER
1205 0849 23 C INC HL
1206 084A 36 12 C LD (HL),12H ;RED PRINT
1207 084C C9 C RET
1208 084D CD 086A C SNDCDU: CALL SNDCHN ;SEND CHANNEL NUMBER
1209 0850 CD 0892 C CALL FNDRAG ;FIND RANGE
1210 0853 06 03 C LD B,03H
1211 0855 CD 065F C CALL BLANK
1212 0858 21 0000* C LD HL,DATA ;SEND DATA
1213 085B CD 08B4 C CALL SNDDA
1214 085E 06 03 C LD B,03H
1215 0860 CD 065F C CALL BLANK
1216 0863 CD 09B9 C CALL SNDUNT ;SEND UNIT
1217 0866 CD 0668 C CALL SEND ;SEND TO PRINTER
1218 0869 C9 C RET
1219 086A FD 21 0000* C SNDCHN: LD IY,SNDBUF
1220 086E 06 02 C LD B,02H
1221 0870 CD 065F C CALL BLANK
1222 0873 21 0000* C LD HL,CHNSND ;CHANGE CHANNEL HEX TO BCD 3 BYTE
1223 0876 CD 0000* C CALL HXTBCD##
1224 0879 47 C LD B,A
1225 087A 1E 30 C LD E,30H
1226 087C 79 C LD A,C
1227 087D 83 C ADD A,E
1228 087E FD 77 00 C LD (IY+0),A ;BCD VALUE IN C,D,B
1229 0881 FD 23 C INC IY
1230 0883 7A C LD A,D
1231 0884 B3 C ADD A,E
1232 0885 FD 77 00 C LD (IY+0),A

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1233	0888	FD 23	C	INC	IY	
1234	088A	78	C	LD	A,B	
1235	088B	83	C	ADD	A,E	
1236	088C	FD 77 00	C	LD	(IY+0),A	
1237	088F	FD 23	C	INC	IY	
1238	0891	C9	C	RET		
1239	0892	01 0000*	C	FNDRAG: LD	BC,CHNSND	;FIND CURRENT SEND RANGE
1240	0895	CD 0000*	C	CALL	CURRAG##	
1241	0898	7E	C	LD	A,(HL)	;CURRENT RANGE IN (HL)
1242	0899	32 0000*	C	LD	(RAGSND),A	;SAVE IN CURRENT RANGE BUFFER
1243	089C	4F	C	LD	C,A	;FIND RANGE FORMAT
1244	089D	06 00	C	LD	B,00H	
1245	089F	21 0000*	C	LD	HL,RAGFMT##	
1246	08A2	09	C	ADD	HL,BC	
1247	08A3	7E	C	LD	A,(HL)	;RANGE FORMAT IN (HL)
1248	08A4	E6 0F	C	AND	0FH	;FIND DECIMAL POINT
1249	08A6	32 0000*	C	LD	(DCMSND),A	;SAVE DECIMAL POINT IN DKMSND
1250	08A9	7E	C	LD	A,(HL)	;FIND UNIT
1251	08AA	1F	C	RRA		
1252	08AB	1F	C	RRA		
1253	08AC	1F	C	RRA		
1254	08AD	1F	C	RRA		
1255	08AE	E6 0F	C	AND	0FH	
1256	08B0	32 0000*	C	LD	(UNTSND),A	;SAVE UNIT IN UNTSND
1257	08B3	C9	C	RET		
1258	08B4	01 0000*	C	SNDDA: LD	BC,CHNSND	;FIND CURRENT SEND DATA
1259	08B7	CD 0000*	C	CALL	CURADD##	
1260	08BA	23	C	INC	HL	;CURRENT ADDRESS IN HL
1261	08BB	CB 6E	C	BIT	5,(HL)	;FIND SIGN
1262	08BD	28 08	C	JR	Z,PASS2	;NO SIGN TO FIND DATA
1263	08BF	FD 2B	C	DEC	IY	
1264	08C1	FD 36 00	C	LD	(IY+0),2DH	;SEND " - "
1265	08C4	2D	C			
1266	08C5	FD 23	C	INC	IY	
1267	08C7	3A 0000*	C	PASS2: LD	A,(DCMSND)	;CHECK DECIMAL POINT
1268	08CA	FE 00	C	CP	00H	
1269	08CC	20 46	C	JR	NZ,HAVEPT	;TO FIND DECIMAL POINT
1270	08CE	FD 36 00	C	LD	(IY+0),20H	;NO DECIMAL SEND BLANK
1271	08D1	20	C			
1272	08D2	FD 23	C	INC	IY	
1273	08D4	7E	C	LD	A,(HL)	;CHECK DATA
1274	08D5	CB 67	C	BIT	4,A	
1275	08D7	20 1C	C	JR	NZ,SENDONE	
1276	08D9	FD 36 00	C	LD	(IY+0),20H	
1277	08DC	20	C			
1278	08DD	FD 23	C	INC	IY	
1279	08DF	E6 0F	C	AND	0FH	
1280	08E1	FE 00	C	CP	00H	
1281	08E3	28 1A	C	JR	Z,BLANK1	;TO BLANK THIRD DIGIT
1282	08E5	CD 09AB	C	PTTRD: CALL	LOAD	;SEND DATA
1283	08E8	CD 09B0	C	PTSEC: CALL	SECDA	;FIND SECOND DATA
1284	08EB	CD 09AB	C	PTSECO: CALL	LOAD	
1285	08EE	7E	C	PTFSTO: LD	A,(HL)	;LOAD FIRST DIGIT
1286	08EF	E6 0F	C	AND	0FH	
1287	08F1	CD 09AB	C	CALL	LOAD	
1288	08F4	C9	C	RET		

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1289	08F5	FD 36 00	C	SNDONE:	LD	(IY+0),31H	
1290	08F8	31	C				
1291	08F9	FD 23	C		INC	IY	
1292	08FB	E6 0F	C		AND	0FH	
1293	08FD	18 E6	C		JR	PTTRD	
1294	08FF	FD 36 00	C	BLANK1:	LD	(IY+0),20H	
1295	0902	20	C				
1296	0903	FD 23	C		INC	IY	
1297	0905	CD 09B0	C		CALL	SECDA	;CHECK SECOND DATA
1298	0908	FE 00	C		CP	00H	
1299	090A	20 DF	C		JR	NZ,PTSEC0	;NOT BLANK
1300	090C	FD 36 00	C		LD	(IY+0),20H	
1301	090F	20	C				
1302	0910	FD 23	C		INC	IY	
1303	0912	18 DA	C		JR	PTFST0	;TO SEND FIRST DIGIT
1304	0914	FE 01	C	HAVEPT:	CP	01H	;ONE DECIMAL POINT
1305	0916	20 41	C		JR	NZ,TWOPT	;TWO DECIMAL POINT
1306	0918	7E	C		LD	A,(HL)	
1307	0919	CB 67	C		BIT	4,A	
1308	091B	20 1D	C		JR	NZ,SNONE0	
1309	091D	FD 36 00	C		LD	(IY+0),20H	
1310	0920	20	C				
1311	0921	FD 23	C		INC	IY	
1312	0923	E6 0F	C		AND	0FH	
1313	0925	FE 00	C		CP	00H	
1314	0927	28 1B	C		JR	Z,BLANK2	;TO BLANK THIRD DIGIT
1315	0929	CD 09AB	C	PTTRD0:	CALL	LOAD	
1316	092C	CD 09B0	C		CALL	SECDA	
1317	092F	CD 09AB	C	PTSEC1:	CALL	LOAD	
1318	0932	FD 36 00	C	PTFST1:	LD	(IY+0),2EH	;SEND DECIMAL POINT
1319	0935	2E	C				
1320	0936	FD 23	C		INC	IY	
1321	0938	18 B4	C		JR	PTFST0	
1322	093A	FD 36 00	C	SNONE0:	LD	(IY+0),31H	
1323	093D	31	C				
1324	093E	FD 23	C		INC	IY	
1325	0940	E6 0F	C		AND	0FH	
1326	0942	18 E5	C		JR	PTTRD0	
1327	0944	FD 36 00	C	BLANK2:	LD	(IY+0),20H	
1328	0947	20	C				
1329	0948	FD 23	C		INC	IY	
1330	094A	CD 09B0	C		CALL	SECDA	
1331	094D	FE 00	C		CP	00H	
1332	094F	20 DE	C		JR	NZ,PTSEC1	
1333	0951	FD 36 00	C		LD	(IY+0),20H	
1334	0954	20	C				
1335	0955	FD 23	C		INC	IY	
1336	0957	18 D9	C		JR	PTFST1	
1337	0959	FE 02	C	TWOPT:	CP	02H	;TWO DECIMAL POINT
1338	095B	20 2F	C		JR	NZ,THRPT	;THREE DECIMAL POINT
1339	095D	7E	C		LD	A,(HL)	
1340	095E	CB 67	C		BIT	4,A	
1341	0960	20 18	C		JR	NZ,SNONE1	
1342	0962	FD 36 00	C		LD	(IY+0),20H	
1343	0965	20	C				
1344	0966	FD 23	C		INC	IY	

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1345 0968 E6 0F C AND 0FH
1346 096A FE 00 C CP 00H
1347 096C 28 16 C JR Z,BLANK3
1348 096E CD 09AB C PTTD1: CALL LOAD
1349 0971 FD 36 00 C PTPNT: LD (IY+0),2EH
1350 0974 2E C
1351 0975 FD 23 C INC IY
1352 0977 C3 08EB C JP PTSEC
1353 097A FD 36 00 C SNONE1: LD (IY+0),31H
1354 097D 31 C
1355 097E FD 23 C INC IY
1356 0980 E6 0F C AND 0FH
1357 0982 18 EA C JR PTTD1
1358 0984 FD 36 00 C BLANK3: LD (IY+0),20H
1359 0987 20 C
1360 0988 FD 23 C INC IY
1361 098A 18 E5 C JR PTPNT
1362 098C 7E C THRPT: LD A,(HL) ;THREE DECIMAL POINT
1363 098D CB 67 C BIT 4,A
1364 098F 20 11 C JR NZ,SNONE2
1365 0991 FD 36 00 C LD (IY+0),20H
1366 0994 20 C
1367 0995 FD 23 C PTTD2: INC IY
1368 0997 FD 36 00 C LD (IY+0),2EH
1369 099A 2E C
1370 099B FD 23 C INC IY
1371 099D E6 0F C AND 0FH
1372 099F C3 08E5 C JP PTTD
1373 09A2 FD 36 00 C SNONE2: LD (IY+0),31H
1374 09A5 31 C
1375 09A6 18 ED C JR PTTD2
1376 09A8 C6 30 C LOAD: ADD A,30H ;CHANGE TO ASCII CODE
1377 09AA FD 77 00 C LD (IY+0),A
1378 09AD FD 23 C INC IY
1379 09AF C9 C RET
1380 09B0 2B C SECDA: DEC HL
1381 09B1 7E C LD A,(HL)
1382 09B2 1F C RRA
1383 09B3 1F C RRA
1384 09B4 1F C RRA
1385 09B5 1F C RRA
1386 09B6 E6 0F C AND 0FH
1387 09B8 C9 C RET
1388 09B9 21 0BAB C SMDUNT: LD HL,UNITS ;UNIT STRING AT UNITS "mV VmA",CF,"C",CF,"F"
1389 09BC 3A 0000* C LD A,(UNTSND) ;FIND UNIT SEND
1390 09BF CB 27 C SLA A
1391 09C1 5F C LD E,A
1392 09C2 16 00 C LD D,00H
1393 09C4 19 C ADD HL,DE
1394 09C5 06 02 C LD B,02H
1395 09C7 CD 064A C CALL FIXED
1396 09CA 06 02 C LD B,02H
1397 09CC CD 065F C CALL BLANK
1398 09CF C9 C RET
1399 C INCLUDE B:PROPRN
1400 C ;*****

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1401          C ;*          PRINT PROGRAM DATA          *
1402          C ;*****
1403          C ;PRINT TIME, DATE, INTERVAL PRINT TIME, HIGH LOW LIMIT, RANGE
1404          C ;
1405          09D0  AF          C PROPRN: XOR    A          ;MARK SEND TO PRINT
1406          09D1  32 0000*  C          LD    (SNDTYP),A
1407          09D4  CD 0823  C SNEQPR: CALL  SNDBNK
1408          09D7  CD 07DE  C          CALL  SNDDATE          ;SEND DATE
1409          09DA  CD 060D  C          CALL  SNDTM           ;SEND TIME
1410          09DD  CD 0A10  C          CALL  SNDPTM          ;SEND INTERVAL PRINT TIME
1411          09E0  21 0B74  C          LD    HL,CHNHL          ;SEND FIXED FORMAT " CH NO.  HLIMIT  "
1412          09E3  CD 0834  C          CALL  SNDFIX
1413          09E6  21 0B88  C          LD    HL,RAGUN          ;SEND FIXED FORMAT " LLIMIT RANGE UNIT "
1414          09E9  CD 0834  C          CALL  SNDFIX
1415          09EC  CD 09F3  C          CALL  SNDPROG          ;SEND PROGRAM DATA
1416          09EF  CD 0823  C          CALL  SNDBNK
1417          09F2  C9          C          RET
1418          09F3  3E FF      C SNDPROG: LD    A,OFFH          ;START AT CHANNEL 00H
1419          09F5  32 0000*  C          LD    (CHNSND),A
1420          09F8  21 0000*  C SNDNTC: LD    HL,CHNSND
1421          09FB  34          C          INC    (HL)          ;INCREMENT CHANNEL
1422          09FC  3E FF      C          LD    A,OFFH          ;STOP AT CHANNEL OFFH
1423          09FE  BE          C          CP    (HL)
1424          09FF  C8          C          RET    Z
1425          0A00  7E          C          LD    A,(HL)          ;CHECK CHANNEL = XF
1426          0A01  E6 0F      C          AND    0FH
1427          0A03  FE 0F      C          CP    0FH
1428          0A05  20 01      C          JR    NZ,PASS1
1429          0A07  34          C          INC    (HL)
1430          0A08  CD 0A50  C PASS1: CALL  SNDCHL          ;SEND CHANNEL AND HIGH LIMIT
1431          0A0B  CD 0A6A  C          CALL  SNDLRU          ;SEND LOW LIMIT, RANGE AND UNIT
1432          0A0E  18 EB      C          JR    SNDNTC
1433          0A10  FD 21 0000* C SNDPTM: LD    IY,SNDBUF
1434          0A14  06 0C      C          LD    B,0CH
1435          0A16  CD 065F  C          CALL  BLANK
1436          0A19  21 0AFA  C          LD    HL,MODES+14          ;PRINT "PROGRAM"
1437          0A1C  06 08      C          LD    B,08H
1438          0A1E  CD 064A  C          CALL  FIXED
1439          0A21  CD 0668  C          CALL  SEND
1440          0A24  FD 21 0000* C          LD    IY,SNDBUF
1441          0A28  21 0B9C  C          LD    HL,PRINTS          ;PRINT TIME STRING AT PRINTS
1442          0A2B  06 0C      C          LD    B,0CH          ;"PRINT TIME  "
1443          0A2D  CD 064A  C          CALL  FIXED
1444          0A30  21 0003*  C          LD    HL,PRTM+3          ;PRINT TIME DATA
1445          0A33  06 02      C          LD    B,02H
1446          0A35  CD 063E  C          CALL  NASCII
1447          0A38  FD 36 00  C          LD    (IY+0),3AH          ;":"
1448          0A3B  3A          C
1449          0A3C  FD 23      C          INC    IY
1450          0A3E  06 02      C          LD    B,02H
1451          0A40  CD 063E  C          CALL  NASCII
1452          0A43  06 02      C          LD    B,02H
1453          0A45  CD 065F  C          CALL  BLANK
1454          0A48  FD 36 00  C          LD    (IY+0),0AH
1455          0A4B  0A          C
1456          0A4C  CD 0668  C          CALL  SEND

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1457 0A4F C9 C RET
1458 0A50 CD 086A C SNDCHL: CALL SNDCHN ;SEND CHANNEL
1459 0A53 CD 0892 C CALL FNDRAG ;FIND RANGE
1460 0A56 06 06 C LD B,06H
1461 0A58 CD 065F C CALL BLANK
1462 0A5B 21 0000* C LD HL,HLIMT ;SEND HIGH LIMIT DATA
1463 0A5E CD 08B4 C CALL SNDDA
1464 0A61 06 04 C LD B,04H
1465 0A63 CD 065F C CALL BLANK
1466 0A66 CD 0668 C CALL SEND ;SEND TO PRINTER
1467 0A69 C9 C RET
1468 0A6A FD 21 0000* C SNDLRU: LD IY,SNDBUF
1469 0A6E FD 36 00 C LD (IY+0),20H
1470 0A71 20 C
1471 0A72 FD 23 C INC IY
1472 0A74 21 0000* C LD HL,LLIMT ;SEND LOW LIMIT DATA
1473 0A77 CD 08B4 C CALL SNDDA
1474 0A7A 06 03 C LD B,03H
1475 0A7C CD 065F C CALL BLANK
1476 0A7F CD 0ABE C CALL SNDRAG ;SEND RANGE
1477 0A82 06 05 C LD B,05H
1478 0A84 CD 065F C CALL BLANK
1479 0A87 CD 09B9 C CALL SNDUNT ;SEND UNIT
1480 0A8A CD 0668 C CALL SEND ;SEND TO PRINTER
1481 0A8D C9 C RET
1482 0A8E 3A 0000* C SNDRAG: LD A,(RAGSND) ;FIND RANGE TO SEND
1483 0A91 E6 0F C AND 0FH
1484 0A93 FE 0A C CP 0AH ;FIND TWO BYTE DATA
1485 0A95 30 0A C JR NC,TBSND
1486 0A97 FD 36 00 C LD (IY+0),20H
1487 0A9A 20 C
1488 0A9B FD 23 C INC IY
1489 0A9D CD 09AB C CALL LOAD
1490 0AA0 C9 C RET
1491 0AA1 FD 36 00 C TBSND: LD (IY+0),31H ;SEND " 1 "
1492 0AA4 31 C
1493 0AA5 FD 23 C INC IY
1494 0AA7 D6 0A C SUB 0AH
1495 0AA9 CD 09AB C CALL LOAD
1496 0AAC C9 C RET
1497 C INCLUDE B:SERCOM
1498 C ;*****
1499 C ;* SERIAL COMMUNICATION *
1500 C ;*****
1501 C ;SEND SERIAL SET OF DATA
1502 C ;
1503 0AAD 3E 01 C SERCOM: LD A,01H ;SET TO SERIAL SEND
1504 0AAF 32 0000* C LD (SNDTYP),A
1505 0AB2 AF C XOR A ;SET XOR STATUS
1506 0AB3 32 0000* C LD (XORST),A
1507 0AB6 3A 0000* C LD A,(SERIN)
1508 0AB9 FE 01 C CP 01H
1509 0ABB 2B 25 C JR Z,ENQDAT ;ENQUIRY FOR DATA
1510 0ABD FE 02 C CP 02H
1511 0ABF 2B 26 C JR Z,ENQPRD ;ENQUIRY FOR PROGRAM
1512 0AC1 C9 C RET

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1513  OAC2  FD 21 0000* C SERSTP: LD      IY,SNDBUF
1514  OAC6  3A 0000* C          LD      A,(XORBUF)      ;SEND XOR DATA
1515  OAC9  FD 77 00   C          LD      (IY+0),A
1516  OACC  FD 23     C          INC      IY
1517  OACE  FD 36 00   C          LD      (IY+0),0DH      ;SEND "CR"
1518  OAD1  0D        C
1519  OAD2  FD 23     C          INC      IY
1520  OAD4  06 12     C          LD      B,12H      ;SEND NUL 18 BYTE
1521  OAD6  FD 36 00 C SNDNUL: LD      (IY+0),00H
1522  OAD9  00        C
1523  OADA  FD 23     C          INC      IY
1524  OADC  10 F8     C          DJNZ    SNDNUL
1525  OADE  CD 0668   C          CALL   SEND
1526  OAE1  C9        C          RET
1527  OAE2  CD 06EC   C ENQDAT: CALL   SNEQDA      ;SEND DATA
1528  OAE5  18 DB     C          JR      SERSTP
1529  OAE7  CD 09D4   C ENQPRO: CALL   SNEQPR      ;SEND PROGRAM
1530  OAEA  18 D6     C          JR      SERSTP
1531                C          INCLUDE B:DEFM
1532                C ;*****
1533                C ;*      DEFINE ASCII STRING      *
1534                C ;*****
1535                C ;
1536  OAEC  52 55 4E   C MODES:  DEFM   'RUN  HOLD  PROGRAM'
1537  OAEF  20 20 20   C
1538  OAF2  20 48 4F   C
1539  OAF5  4C 44 20   C
1540  OAF8  20 20 50   C
1541  OAFB  52 4F 47   C
1542  OAFE  52 41 4D   C
1543  OB01  20 20 44   C DATES:  DEFM   '  DATE  '
1544  OB04  41 54 45   C
1545  OB07  20 20 20   C
1546  OB0A  54 49 4D   C TIMES:  DEFM   'TIME  '
1547  OB0D  45 20 20   C
1548  OB10  20 20 43   C CHDAUN: DEFM   '  CH NO. DATA UNIT '
1549  OB13  48 20 4E   C
1550  OB16  4F 2E 20   C
1551  OB19  44 41 54   C
1552  OB1C  41 20 20   C
1553  OB1F  55 4E 49   C
1554  OB22  54 20     C
1555  OB24  20 20 2A   C UNLOW:  DEFM   ' * UNDER LOW LIMIT',LF
1556  OB27  20 55 4E   C
1557  OB2A  44 45 52   C
1558  OB2D  20 4C 4F   C
1559  OB30  57 20 4C   C
1560  OB33  49 4D 49   C
1561  OB36  54 0A     C
1562  OB38  20 20 2A   C OVHIGH: DEFM   ' * OVER HIGH LIMIT',LF
1563  OB3B  20 4F 56   C
1564  OB3E  45 52 20   C
1565  OB41  48 49 47   C
1566  OB44  48 20 4C   C
1567  OB47  49 4D 49   C
1568  OB4A  54 0A     C

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1569	0B4C	20 20 2A	C	OVRNGE:	DEFM	' * OVER RANGE	,LF
1570	0B4F	20 4F 56	C				
1571	0B52	45 52 20	C				
1572	0B55	52 41 4E	C				
1573	0B58	47 45 20	C				
1574	0B5B	20 20 20	C				
1575	0B5E	20 0A	C				
1576	0B60	20 20 20	C	NOTFD:	DEFM	' NOT FOUND	,LF
1577	0B63	20 20 4E	C				
1578	0B66	4F 54 20	C				
1579	0B69	46 4F 55	C				
1580	0B6C	4E 44 20	C				
1581	0B6F	20 20 20	C				
1582	0B72	20 0A	C				
1583	0B74	20 20 43	C	CHNHL:	DEFM	' CH NO. HLINT	
1584	0B77	48 20 4E	C				
1585	0B7A	4F 2E 20	C				
1586	0B7D	20 20 48	C				
1587	0B80	4C 49 4D	C				
1588	0B83	54 20 20	C				
1589	0B86	20 20	C				
1590	0B88	20 4C 4C	C	RAGUN:	DEFM	' LLINT RANGE UNIT	
1591	0B8B	49 4D 54	C				
1592	0B8E	20 20 52	C				
1593	0B91	41 4E 47	C				
1594	0B94	45 20 20	C				
1595	0B97	55 4E 49	C				
1596	0B9A	54 20	C				
1597	0B9C	50 52 49	C	PRINTS:	DEFM	' PRINT TIME	
1598	0B9F	4E 54 20	C				
1599	0BA2	54 49 4D	C				
1600	0BA5	45 20 20	C				
1601	0BAB	6D 56 20	C	UNITS:	DEFM	' mV VmA	
1602	0BAB	56 6D 41	C				
1603	0BAE	20 43	C		DEFM	' C'	
1604	0BB0	20 46	C		DEFM	' F'	
1605	0BB2	20 20 20	C	CHULA:	DEFM	' CHULALONGKORN	
1606	0BB5	20 43 4B	C				
1607	0BB8	55 4C 41	C				
1608	0BBB	4C 4F 4E	C				
1609	0BBE	47 4B 4F	C				
1610	0BC1	52 4E 20	C				
1611	0BC4	20 20	C				
1612	0BC6	20 20 20	C	UNIV:	DEFM	' UNIVERSITY	,LF
1613	0BC9	20 20 55	C				
1614	0BCC	4E 49 56	C				
1615	0BCF	45 52 53	C				
1616	0BD2	49 54 59	C				
1617	0BD5	20 20 20	C				
1618	0BD8	20 0A	C				
1619	0BDA	20 20 20	C	ELECT:	DEFM	' ELECTRICAL	
1620	0BDD	20 20 20	C				
1621	0BE0	20 20 20	C				
1622	0BE3	45 4C 45	C				
1623	0BE6	43 54 52	C				
1624	0BE9	49 43 41	C				

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1625  OBEC  4C 20      C
1626  OBEE  45 4E 47  C ENGIN:  DEFW  'ENGINEERING  ',LF
1627  OBF1  49 4E 45  C
1628  OBF4  45 52 49  C
1629  OBF7  4E 47 20  C
1630  OBFA  20 20 20  C
1631  OBFD  20 20 20  C
1632  OC00  20 0A      C
1633  000A      C LF      EQU      0AH
1634      C          INCLUDE B:LINTBL
1635      C ;*****
1636      C ;*          LINEARLIZE TABLE      *
1637      C ;*****
1638      C ;
1639      C          DEFW  0322D          ;THERMOCOUPLE SENSOR
1640      C          DEFW  10680D          ;RANGE -199.9 - 199.9 C
1641      C          DEFW  -64000D
1642      C          DEFW  0322D
1643      C          DEFW  10680D
1644      C          DEFW  -23564D
1645      C          DEFW  0360D
1646      C          DEFW  09240D
1647      C          DEFW  -22920D
1648      C          DEFW  0392D
1649      C          DEFW  08088D
1650      C          DEFW  -22200D
1651      C          DEFW  0426D
1652      C          DEFW  06932D
1653      C          DEFW  -21416D
1654      C          DEFW  0458D
1655      C          DEFW  05908D
1656      C          DEFW  -20564D
1657      C          DEFW  0486D
1658      C          DEFW  05068D
1659      C          DEFW  -19648D
1660      C          DEFW  0518D
1661      C          DEFW  04172D
1662      C          DEFW  -18076D
1663      C          DEFW  0544D
1664      C          DEFW  03496D
1665      C          DEFW  -17640D
1666      C          DEFW  0572D
1667      C          DEFW  02824D
1668      C          DEFW  -16552D
1669      C          DEFW  0598D
1670      C          DEFW  02252D
1671      C          DEFW  -15408D
1672      C          DEFW  0622D
1673      C          DEFW  01772D
1674      C          DEFW  -14212D
1675      C          DEFW  0644D
1676      C          DEFW  01376D
1677      C          DEFW  -12968D
1678      C          DEFW  0668D
1679      C          DEFW  00992D
1680      C          DEFW  -11680D

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1681	OC56	02AE	C	DEFW	0686D
1682	OC58	02E4	C	DEFW	00740D
1683	OC5A	D798	C	DEFW	-10344D
1684	OC5C	02C4	C	DEFW	0708D
1685	OC5E	01DC	C	DEFW	00476D
1686	OC60	DCF4	C	DEFW	-08972D
1687	OC62	02D4	C	DEFW	0724D
1688	OC64	013C	C	DEFW	00316D
1689	OC66	E27C	C	DEFW	-07556D
1690	OC68	02E6	C	DEFW	0742D
1691	OC6A	00AC	C	DEFW	00172D
1692	OC6C	E824	C	DEFW	-06108D
1693	OC6E	02F6	C	DEFW	0758D
1694	OC70	004C	C	DEFW	00076D
1695	OC72	EDF0	C	DEFW	-04624D
1696	OC74	0302	C	DEFW	0770D
1697	OC76	001C	C	DEFW	00028D
1698	OC78	F3DC	C	DEFW	-03108D
1699	OC7A	0310	C	DEFW	0784D
1700	OC7C	0000	C	DEFW	00000D
1701	OC7E	F9E0	C THCP1:	DEFW	-01568D
1702	OC80	031A	C	DEFW	0794D
1703	OC82	0000	C	DEFW	00000D
1704	OC84	0634	C	DEFW	01588D
1705	OC86	0322	C	DEFW	0802D
1706	OC88	0010	C	DEFW	00016D
1707	OC8A	0C78	C	DEFW	03192D
1708	OC8C	032A	C	DEFW	0810D
1709	OC8E	0030	C	DEFW	00048D
1710	OC90	12CC	C	DEFW	04812D
1711	OC92	0330	C	DEFW	0816D
1712	OC94	0054	C	DEFW	00084D
1713	OC96	192C	C	DEFW	06444D
1714	OC98	0336	C	DEFW	0822D
1715	OC9A	0084	C	DEFW	00132D
1716	OC9C	1F98	C	DEFW	08088D
1717	OC9E	033C	C	DEFW	0828D
1718	OCA0	00C0	C	DEFW	00192D
1719	OCA2	2610	C	DEFW	09744D
1720	OCA4	033C	C	DEFW	0828D
1721	OCA6	00C0	C	DEFW	00192D
1722	OCA8	2C88	C	DEFW	11400D
1723	OCAA	0340	C	DEFW	0832D
1724	OCAC	00F8	C	DEFW	00248D
1725	OCAE	3308	C	DEFW	13064D
1726	OCB0	033E	C	DEFW	0830D
1727	OCB2	00D8	C	DEFW	00216D
1728	OCB4	3984	C	DEFW	14724D
1729	OCB6	033C	C	DEFW	0828D
1730	OCB8	00B4	C	DEFW	00180D
1731	OCBA	3FFC	C	DEFW	16380D
1732	OCBC	033A	C	DEFW	0826D
1733	OCBE	008C	C	DEFW	00140D
1734	OCC0	4670	C	DEFW	18032D
1735	OCC2	0336	C	DEFW	0822D
1736	OCC4	0034	C	DEFW	00052D

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1737	OCC6	4CDC	C	DEFW	19676D	
1738	OCC8	0330	C	DEFW	0816D	
1739	OCCA	FFA4	C	DEFW	-0092D	
1740	OCCC	533C	C	DEFW	21308D	
1741	OCCE	032C	C	DEFW	0812D	
1742	OCDO	FF3C	C	DEFW	-0196D	
1743	OCD2	5994	C	DEFW	22932D	
1744	OCD4	0328	C	DEFW	0808D	
1745	OCD6	FECC	C	DEFW	-0308D	
1746	OCD8	5FE4	C	DEFW	24548D	
1747	OCDA	0324	C	DEFW	0804D	
1748	OCDC	FE54	C	DEFW	-0428D	
1749	OCDE	662C	C	DEFW	26156D	
1750	OCEO	0320	C	DEFW	0800D	
1751	OCE2	FDD4	C	DEFW	-0556D	
1752	OCE4	6C6C	C	DEFW	27756D	
1753	OCE6	031E	C	DEFW	0798D	
1754	OCE8	FD90	C	DEFW	-0624D	
1755	OCEA	72A8	C	DEFW	29352D	
1756	OCEC	031E	C	DEFW	0798D	
1757	OCEE	FD90	C	DEFW	-0624D	
1758	OCF0	78E4	C	DEFW	30948D	
1759	OCF2	0320	C	DEFW	0800D	
1760	OCF4	FDDC	C	DEFW	-0548D	
1761	OCF6	7F24	C	DEFW	32548D	
1762	OCF8	0320	C	DEFW	0800D	
1763	OCFA	FDDC	C	DEFW	-0548D	
1764	OCFC	FA00	C	DEFW	64000D	
1765			C ;			
1766	OCFE	046E	C	DEFW	1134D	;RESISTANCE BULB PT 100 SENSOR
1767	OD00	F817	C	DEFW	-2025D	;RANGE -199.9 - 199.9 C
1768	OD02	0600	C	DEFW	-64000D	
1769	OD04	0472	C	DEFW	1138D	
1770	OD06	F75D	C	DEFW	-2211D	
1771	OD08	5FA8	C	DEFW	-41048D	
1772	OD0A	046D	C	DEFW	1133	
1773	OD0C	F82E	C	DEFW	-2002D	
1774	OD0E	688D	C	DEFW	-38771D	
1775	OD10	0467	C	DEFW	1127D	
1776	OD12	F8F3	C	DEFW	-1805D	
1777	OD14	7166	C	DEFW	-36506D	
1778	OD16	045C	C	DEFW	1116D	
1779	OD18	FA50	C	DEFW	-1456D	
1780	OD1A	7A34	C	DEFW	-34252D	
1781	OD1C	0454	C	DEFW	1108D	
1782	OD1E	FB49	C	DEFW	-1207D	
1783	OD20	82EB	C	DEFW	-32021D	
1784	OD22	044B	C	DEFW	1099D	
1785	OD24	FC34	C	DEFW	-0972D	
1786	OD26	8CBF	C	DEFW	-29505D	
1787	OD28	0445	C	DEFW	1093D	
1788	OD2A	FCC5	C	DEFW	-0827D	
1789	OD2C	9429	C	DEFW	-27607D	
1790	OD2E	043D	C	DEFW	1085D	
1791	OD30	FD8D	C	DEFW	-0627D	
1792	OD32	9CB4	C	DEFW	-25420D	

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1793	0D34	0438	C	DEFW	1080D
1794	0D36	FE0A	C	DEFW	-0502D
1795	0D38	A52F	C	DEFW	-23249D
1796	0D3A	0432	C	DEFW	1074D
1797	0D3C	FE7C	C	DEFW	-0388D
1798	0D3E	AD9E	C	DEFW	-21090D
1799	0D40	042C	C	DEFW	1068D
1800	0D42	FEE3	C	DEFW	-0285D
1801	0D44	B602	C	DEFW	-18942D
1802	0D46	0429	C	DEFW	1065D
1803	0D48	FF13	C	DEFW	-0237D
1804	0D4A	BE5A	C	DEFW	-16806D
1805	0D4C	0424	C	DEFW	1060D
1806	0D4E	FF61	C	DEFW	-0159D
1807	0D50	C6AD	C	DEFW	-14675D
1808	0D52	0421	C	DEFW	1057D
1809	0D54	FF87	C	DEFW	-0121D
1810	0D56	CEF4	C	DEFW	-12556D
1811	0D58	041B	C	DEFW	1051D
1812	0D5A	FFBE	C	DEFW	-0066D
1813	0D5C	D735	C	DEFW	-10443D
1814	0D5E	0418	C	DEFW	1048D
1815	0D60	FFD6	C	DEFW	-0042D
1816	0D62	DFAA	C	DEFW	-08214D
1817	0D64	0415	C	DEFW	1045D
1818	0D66	FFE9	C	DEFW	-0023D
1819	0D68	E79A	C	DEFW	-06246D
1820	0D6A	0412	C	DEFW	1042D
1821	0D6C	FFF5	C	DEFW	-0011D
1822	0D6E	EFC4	C	DEFW	-04156D
1823	0D70	040C	C	DEFW	1036D
1824	0D72	0000	C	DEFW	0000D
1825	0D74	F7E8	C RESB1:	DEFW	-02072D
1826	0D76	0409	C	DEFW	1033
1827	0D78	0000	C	DEFW	0000D
1828	0D7A	0812	C	DEFW	02066D
1829	0D7C	0406	C	DEFW	1030D
1830	0D7E	FFFA	C	DEFW	-0006D
1831	0D80	101F	C	DEFW	04127D
1832	0D82	0403	C	DEFW	1027D
1833	0D84	FFEE	C	DEFW	-0018D
1834	0D86	1825	C	DEFW	06181D
1835	0D88	03FE	C	DEFW	1022D
1836	0D8A	FFCD	C	DEFW	-0051D
1837	0D8C	2020	C	DEFW	08224D
1838	0D8E	03FB	C	DEFW	1019D
1839	0D90	FFB4	C	DEFW	-0076D
1840	0D92	2815	C	DEFW	10261D
1841	0D94	03F8	C	DEFW	1016D
1842	0D96	FF97	C	DEFW	-0105D
1843	0D98	3004	C	DEFW	12292D
1844	0D9A	03F5	C	DEFW	1013D
1845	0D9C	FF73	C	DEFW	-0141D
1846	0D9E	37EE	C	DEFW	14318D
1847	0DA0	03EF	C	DEFW	1007D
1848	0DA2	FF24	C	DEFW	-0220D

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1849	ODA4	3FCC	C	DEFW	16332D	
1850	ODA6	03EF	C	DEFW	1007D	
1851	ODA8	FF1E	C	DEFW	-0226D	
1852	ODAA	47A9	C	DEFW	18345D	
1853	ODAC	03E9	C	DEFW	1001D	
1854	ODAE	FEB9	C	DEFW	-0327D	
1855	ODB0	4F7B	C	DEFW	20347D	
1856	ODB2	03E6	C	DEFW	0998D	
1857	ODB4	FE7F	C	DEFW	-0385D	
1858	ODB6	5747	C	DEFW	22343D	
1859	ODB8	03E3	C	DEFW	0995D	
1860	ODBA	FE3D	C	DEFW	-0451D	
1861	ODBC	5F0D	C	DEFW	24333D	
1862	ODBE	03DE	C	DEFW	0990D	
1863	ODC0	FDB7	C	DEFW	-0585D	
1864	ODC2	66C8	C	DEFW	26312D	
1865	ODC4	03DD	C	DEFW	0989D	
1866	ODC6	FDAF	C	DEFW	-0593D	
1867	ODC8	6E83	C	DEFW	28291D	
1868	ODCA	03D8	C	DEFW	0984D	
1869	ODCC	FD12	C	DEFW	-0750D	
1870	ODCE	7632	C	DEFW	30258D	
1871	ODD0	03D5	C	DEFW	0981D	
1872	ODD2	FCB8	C	DEFW	-0840D	
1873	ODD4	7DD8	C	DEFW	32219D	
1874	ODD6	03D2	C	DEFW	0978D	
1875	ODD8	FC5B	C	DEFW	-0933D	
1876	ODDA	857E	C	DEFW	34174D	
1877	ODDC	03CF	C	DEFW	0975D	
1878	ODDE	FBF5	C	DEFW	-1035D	
1879	ODE0	8D1C	C	DEFW	36124D	
1880	ODE2	03C9	C	DEFW	0969D	
1881	ODE4	FB33	C	DEFW	-1229D	
1882	ODE6	94AE	C	DEFW	38062D	
1883	ODE8	03C9	C	DEFW	0969D	
1884	ODEA	FB20	C	DEFW	-1248D	
1885	ODEC	FA00	C	DEFW	64000D	
1886			C ;			
1887	ODEE	0000	C	DEFW	00000D	
1888	ODF0	71	C	DEFB	0113D	
1889	ODF1	0118	C CDJC1:	DEFW	00280D	; COLD JUNCTION COMPENSATION
1890	ODF3	FDCE	C	DEFW	-0562D	
1891	ODF5	73	C	DEFB	115D	
1892	ODF6	0186	C	DEFW	00390D	
1893	ODF8	0000	C	DEFW	00000D	
1894	ODFA	73	C	DEFB	115D	
1895	ODFB	07D0	C	DEFW	02000D	
1896				.DEPHASE		
1897				END		

Macros:

Symbols:

07BA	ABCHN	052F	ADD1	0541	ADD2
23D0*	ADDAT	05A9	ADDCD	02E7	ADDS
04F3	ADDY	2012*	ADINT	225E*	ADINT1
2056*	BATT1	2059*	BATT2	0188	BCUCHN
0150	BDLY	02F2	BITBD	065F	BLANK
08FF	BLANK1	0944	BLANK2	0984	BLANK3
0000*	C8251	0018	CAINIT	045F	CALDT
0488	CALDT1	0564	CALDT2	017D	CAPASS
074D	CCKFND	0515	CDCOMP	0DF1	CDJC1
016D	CGECHN	0B10	CHDAUN	219E*	CHDIS
2061*	CHDISD	059D	CH6SN	0780	CHKFND
0B74	CHNHL	29F9*	CHNSND	0BB2	CHULA
02B3	CKEND	07D1	CKFND	07B3	CKFOND
024E	CKINT	21B7*	CKNPG	01FD	CKPRNT
050E	CKREM	27C3*	CKUSE	0654	CLRBUF
04EB	COMPLE	0459	CLOW	04B0	CLOW1
055C	CLOW2	0000*	CTC0	0000*	CTC1
0000*	CTC2	0000*	CTC3	0000*	CTRL1
0000*	CTRL2	0000*	CTRL3	2842*	CTRLP
2820*	CTRLS	28B8*	CURADD	2896*	CURRAG
2183*	CUSCHN	0000*	D8251	02BE	DAPROC
2859*	DATA	0B01	DATES	213F*	DATHLD
28C8*	DCMSND	06B4	DELAY2	2109*	DISB
04FA	DIVIDE	0153	DLY	0BDA	ELECT
0BEE	ENGIN	015B	ENLPRN	0AE2	ENQDAT
0AE7	ENQPRO	2039*	FIRST	064A	FIXED
0892	FNDRAG	27D2*	FOUND	06D1	FTGXOR
06BE	FTXOR	21E6*	FUNDIS	033E	HALM
0914	HAVEPT	0105	HEAD	2106*	HEADIS
0372	HIGHL	06E8	HLDPN	2A5C*	HLINT
2307*	HUNDAT	2877*	HXTBCD	00BE	INIINTF
0053	INIPRO	00B9	INIT1	00B3	INIT2
00A8	INIT3	00A3	INIT4	014E	INITDLY
0038	INITIAL	0010	INTRTN	2223*	INTVTM
0378	LALM	000A	LF	0841	LFRED
0434	LINEAR	2A75*	LLINT	09A8	LOAD
03B4	LOWL	23E9*	LSTCU	0288	MHOUR
0AEC	MODES	056D	NADD	063E	NASCII
0362	NEGS6N	07A0	NEXTCH	031D	NLOP
020E	NOPRNT	0242	NOSER	0682	NOTCTRL
0B60	NOTFD	21DF*	NOTPRG	06DB	NOTXOR
076D	NTCH	070A	NTCHN	0313	NTLOP
026F	NTRD	04FD	NTSUB2	01C4	NXT
073A	NXTCHN	044B	NXTCP	0452	NXTCP1
04A4	NXTCP2	04A8	NXTCP3	0551	NXTCP4
0555	NXTCP5	0182	DCHN	03CB	OFFSET
25EF*	OPFUNC	03D7	OVER	0B38	OVHIGH
0B4C	OVRNGE	217E*	PASS	0A08	PASS1
08C7	PASS2	01DD	PASS3	01CA	PASS4
01D2	PASS5	02DA	PASS6	01E1	PASS7
052B	PASS8	0533	PASS9	0000*	PIOCA
0000*	PIOCB	21FB*	PMOTM	0000*	PORTA1

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0000*	PORTA2	0000*	PORTB1	0000*	PORTB2
0000*	PORTC1	0000*	PORTC2	0494	POSDAT
03A0	POSSGN	0000*	POWDLY	0002	POWER
0249	PRGM	0B9C	PRINTS	05CC	PRMOTM
2210*	PRNT	01A8	PROC	09D0	PROPRN
2A31*	PRTM	08EE	PTFST0	0932	PTFST1
0971	PTPNT	08E8	PTSEC	08EB	PTSECO
092F	PTSEC1	08E5	PTTRD	0929	PTTRDO
096E	PTTRD1	0995	PTTRD2	28A0*	RAGFMT
03E7	RAGLIN	05AC	RAGSEN	2A8F*	RAGSND
0B88	RAGUN	2075*	RANGE	03FF	RANGE0
0401	RANGE1	0421	RANGE10	0423	RANGE11
0425	RANGE12	042E	RANGE13	0430	RANGE14
0432	RANGE15	0403	RANGE2	0405	RANGE3
0407	RANGE4	0409	RANGE5	040B	RANGE6
040D	RANGE7	040F	RANGE8	0411	RANGE9
02691	READTM	219B*	REFCHN	0192	REFSH
21A4*	REFST	0D74	RESB1	02DF	SAMSN
03BA	SAVE	0279	SAVETH	2016*	SCNINT
09B0	SECDA	0167	SELCHN	0668	SEND
06AB	SERAGN	0AAD	SERCOM	2AB7*	SERIN
2014*	SERINT	06A4	SERSND	0AC2	SERSTP
02FD	SHIFT	071D	SNDABN	067B	SNDAGN
0823	SNDBNK	2AC4*	SNDBUF	084D	SNDCDU
0A50	SNDCHL	086A	SNDCHN	08B4	SNDDA
0705	SNDDATA	07DE	SNDDATE	0834	SNDFIX
0688	SNDLOOP	0A6A	SNDLRU	0000*	SNDLY
05D7	SNDMD	09F8	SNDNTC	0AD6	SNDNUL
08F5	SNDONE	0693	SNDPORT	09F3	SNDPROG
0A10	SNDPTH	0A8E	SNDRAG	060D	SNDTH
2AB0*	SNDTYP	09B9	SNDUNT	06EC	SNEQDA
09D4	SNEQPR	093A	SNONE0	097A	SNONE1
09A2	SNONE2	0000*	START	2005*	STKPT
0AA1	TBSND	0507	TENMUL	0C7E	THCP1
098C	THRPT	280F*	TIMED	0B0A	TIMES
2145*	TIMHLD	05FB	TRANS	0959	TWOPT
06DE1	TX	0BAB	UNITS	0BC6	UNIV
0B24	UNLOW	29BD*	UNTSND	2AC7*	XORBUF
2AB4*	XORST				

No Fatal error(s)

C

PASS1	1428	1430#						
PASS2	1262	1267#						
PASS3	262	269#						
PASS4	256	258#						
PASS5	259	263#						
PASS6	410	412#	415	417	425			
PASS7	250	268	271#					
PASS8	800	802#						
PASS9	803	807#						
PIOCA	117	120						
PIOCB	118	121						
PMOTM	3#	277	282					
PORTA1	1010							
PORTA2	243	246	272	275	284	294	302	305
PORTB1	161	342	1012	1014				
PORTB2	217							
PORTC1	345	358	1006					
PORTC2	510	550	569					
POSDAT	638	698#						
POSS6N	520	535#						
PODWLY	14							
POWER	15#	15						
PRGM	288	317#						
PRINTS	1441	1597#						
PRMOTM	280	913#						
PRNT	3#	286	292					
PROC	35	242#	316					
PROPRN	317	1405#						
PRTM	6#	67	1444					
PTFST0	1285#	1303	1321					
PTFST1	1318#	1336						
PTPNT	1349#	1361						
PTSEC	1283#	1352						
PTSECO	1284#	1299						
PTSEC1	1317#	1332						
PTTRD	1282#	1293	1372					
PTTRD0	1315#	1326						
PTTRD1	1348#	1357						
PTTRD2	1367#	1375						
RAGFMT	1245							
RAGLIN	412	584#						
RAGSEN	590	890#						
RAGSND	5#	1242	1482					
RAGUN	1413	1590#						
RANGE	6#	70						
RANGE0	599#	890						
RANGE1	601#	891						
RANGE10	623#	900						
RANGE11	625#	901						

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1      0000'          ASEG
2                      ORG      3000H
3                      .PHASE   2000H
4                      C        INCLUDE B:FUNDIS
5                      C ;*****
6                      C ;*      OPERATED FUNCTION DISPLAY      *
7                      C ;*****
8                      C ;DISPLAY DATA CORESSPONDED TO KEY OPERATED FUNCTION
9                      C ;CHECK MODE OPERATION AND JUMP TO OPERATED FUNCTION
10                     C ;
11      2000  3A 1813  C FUNDIS:: LD      A,(OPFUNC)      ;CHECK MODE
12      2003  CB 7F   C          BIT      7,A
13      2005  20 0F   C          JR       NZ,HPROFC      ;NOT RUN MODE TO HOLD AND PROGRAM MODE
14      2007  3A 180F C          LD      A,(CHTM)        ;CHECK CHANGE CHANNEL COMMAND
15      200A  FE 01   C          CP       01H
16      200C  CC 2057 C          CALL    Z,CHGCHN      ;CALL CHANGE CHANNEL
17      200F  AF     C          XOR      A              ;RESET COMMAND
18      2010  32 180F C          LD      (CHTM),A
19      2013  C3 20A4 C          JP       CHDATA        ;TO DISPLAY CHANNEL AND DATA
20      2016  CB 77   C HPROFC: BIT      6,A
21      2018  20 39   C          JR       NZ,PMODE      ;TO PROGRAM MODE
22      201A  0E 00   C          LD      C,00H          ;SET JUMP COUNTER IN HOLD MODE
23      201C  CB 6F   C FINDF:  BIT      5,A
24      201E  20 11   C          JR       NZ,CTDI        ;TO FUNCTION CHANNEL, TIME, DATE, INTV
25      2020  E6 3F   C          AND      3FH          ;SET BIT 6 , 7 TO 0
26      2022  28 22   C          JR       Z,MAPJP        ;TO NOFUNCTION
27      2024  0C     C          INC      C              ;C = 01H OR 09H
28      2025  CB 57   C          BIT      2,A
29      2027  20 1D   C          JR       NZ,MAPJP        ;TO HIGH LIMIT
30      2029  0C     C          INC      C              ;C = 02H OR 0AH
31      202A  CB 5F   C          BIT      3,A
32      202C  20 18   C          JR       NZ,MAPJP        ;TO LOW LIMIT
33      202E  0C     C          INC      C              ;C = 03H OR 0BH
34      202F  18 15   C          JR       MAPJP          ;TO RANGE
35      2031  0C     C CTDI:   INC      C
36      2032  0C     C          INC      C
37      2033  0C     C          INC      C
38      2034  0C     C          INC      C              ;C = 04H OR 0CH
39      2035  CB 67   C          BIT      4,A
40      2037  28 0D   C          JR       Z,MAPJP        ;TO CHANNEL
41      2039  0C     C          INC      C
42      203A  0C     C          INC      C              ;C = 06H OR 0EH
43      203B  CB 57   C          BIT      2,A
44      203D  20 07   C          JR       NZ,MAPJP        ;TO DATE
45      203F  0C     C          INC      C              ;C = 07H OR 0FH
46      2040  CB 5F   C          BIT      3,A
47      2042  20 02   C          JR       NZ,MAPJP        ;TO INTV
48      2044  0D     C          DEC      C
49      2045  0D     C          DEC      C              ;C = 05H OR 0DH
50      2046  CB 21   C MAPJP:  SLA      C              ;USE TO ADDRESS
51      2048  06 00   C          LD      B,00H
52      204A  21 2952 C          LD      HL,FUDIS        ;ADDRESS OF FUNCTION DISPLAY ROUTINE AT FUDIS
53      204D  09     C          ADD      HL,BC
54      204E  5E     C          LD      E,(HL)
55      204F  23     C          INC      HL
56      2050  56     C          LD      D,(HL)

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57 2051 EB C EX DE,HL
58 2052 E9 C JP (HL) ;JP TO FUNCTION DISPLAY ROUTINE
59 2053 0E 08 C PMODE: LD C,08H ;SET C FOR PROGRAM MODE
60 2055 18 C5 C JR FINDF
61 2057 21 1879 C CHGCHN: LD HL,CHDIS ;INCREMENT CHANNEL DISPLAY
62 205A 34 C INC (HL)
63 205B CD 206F C CALL CKUSE ;CHECK USE CHANNEL
64 205E 20 F7 C JR NZ,CHGCHN
65 2060 21 1879 C LD HL,CHDIS ;CHANGE HEX VALUE TO 3 BYTE BCD
66 2063 CD 2084 C CALL HXTBCD
67 2066 21 187A C LD HL,CHDISD ;SAVE BCD VALUE IN CHDISD
68 2069 77 C LD (HL),A ;FIRST DIGIT AT A
69 206A 23 C INC HL
70 206B 72 C LD (HL),D ;SECOND DIGIT AT D
71 206C 23 C INC HL
72 206D 71 C LD (HL),C ;THIRD DIGIT AT C
73 206E C9 C RET
74 206F 7E C CKUSE:: LD A,(HL) ;CHECK USE CHANNEL AT HIGH LIMIT
75 2070 E6 0F C AND 0FH
76 2072 FE 0F C CP 0FH ;CHECK CHANNEL = XF
77 2074 20 01 C JR NZ,PASS
78 2076 34 C INC (HL)
79 2077 44 C PASS:: LD B,H
80 2078 4D C LD C,L
81 2079 21 1A91 C LD HL,HLIMIT
82 207C CD 2692 C CALL CURADD
83 207F 23 C INC HL
84 2080 7E C LD A,(HL)
85 2081 E6 C0 C AND 0C0H
86 2083 C9 C RET
87 2084 7E C HXTBCD:: LD A,(HL)
88 2085 1F C RRA
89 2086 1F C RRA
90 2087 1F C RRA
91 2088 1F C RRA
92 2089 E6 0F C AND 0FH
93 208B 3D C DEC A
94 208C 47 C LD B,A
95 208D 7E C LD A,(HL)
96 208E 90 C SUB B
97 208F 1E 64 C LD E,64H ;HEX 64H = BCD 100D
98 2091 83 C ADD A,E
99 2092 0E FF C LD C,OFFH ;THIRD DIGIT AT C
100 2094 93 C NTSUB: SUB E
101 2095 0C C INC C
102 2096 BB C CP E
103 2097 30 FB C JR NC,NTSUB
104 2099 1E 0A C LD E,0AH ;HEX 0AH = BCD 10D
105 209B 83 C ADD A,E
106 209C 16 FF C LD D,OFFH ;SECOND DIGIT AT D
107 209E 93 C NTSUB1: SUB E
108 209F 14 C INC D
109 20A0 BB C CP E
110 20A1 30 FB C JR NC,NTSUB1
111 20A3 C9 C RET
112 C INCLUDE B:CHDATA

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113      C ;*****
114      C ;*   CHANNEL AND DATA DISPLAY   *
115      C ;*****
116      C ;DISPLAY CHANNEL AND DATA IN HOLD AND RUN MODE
117      C ;
118      20A4  CD 20BF  C CHDATA: CALL  CHANNL      ;TRANSFER CHANNEL TO DISPLAY BUFFER
119      20A7  21 1891  C          LD    HL,DATA      ;ADDRESS OF DATA CHANNEL 00H
120      20AA  CD 20D1  C          CALL  NUDATA      ;TRANSFER NUMERIC DATA TO DISPLAY BUFFER
121      20AD  3A 1813  C          LD    A,(DPFUNC)    ;CHECK OPERATED MODE
122      20B0  CB 7F    C          BIT    7,A
123      20B2  28 06    C          JR     Z,RUNMD      ;TO RUN MODE
124      20B4  3E 40    C          LD    A,40H      ;DISPLAY HOLD LAMP
125      20B6  DD 77 00  C          LD    (IX+0),A
126      20B9  C9      C          RET
127      20BA  AF      C RUNMD: XOR    A          ;IN RUN MODE NOT SHOW LAMP
128      20BB  DD 77 00  C          LD    (IX+0),A
129      20BE  C9      C          RET
130      20BF  FD 21 187C C CHANNL: LD    IY,CHDISD+2    ;LOAD DECIMAL CHANNEL DISPLAY ADDRESS TO IY
131      20C3  DD 21 1802 C CHSIY: LD    IX,DISB      ;LOAD DISPLAY BUFFER ADDRESS TO IX
132      20C7  CD 2152  C          CALL  DATRAN      ;TRANSFER DATA 3 BYTE
133      20CA  AF      C          XOR    A          ;SEND BLANK TO DIGIT 3
134      20CB  DD 77 00  C          LD    (IX+0),A
135      20CE  DD 23    C          INC    IX          ;TO DIGIT 4 (SIGN)
136      20D0  C9      C          RET
137      20D1  01 1879  C NUDATA: LD    BC,CHDIS
138      20D4  CD 2692  C          CALL  CURADD      ;FIND CURRENT DISPLAY ADDRESS
139      20D7  23      C          INC    HL          ;DISPLAY HIGH BYTE FIRST
140      20D8  E5      C          PUSH   HL          ;TRANSFER REGISTER BY PUSH POP
141      20D9  FD E1    C          POP    IY
142      20DB  DD E5    C          PUSH   IX          ;SAVE DATA IN DATBUF BEFORE TO DISB
143      20DD  DD 21 185B C          LD    IX,DATBUF
144      20E1  FD 7E 00  C          LD    A,(IY+0)    ;TRANSFER SIGN DATA TO DIGIT 4
145      20E4  06 00    C          LD    B,00H      ;CHECK THOUSAND DIGIT
146      20E6  CB 67    C          BIT    4,A
147      20E8  28 02    C          JR     Z,NOTSD
148      20EA  06 30    C          LD    B,30H      ;SEGMENT CODE OF ONE
149      20EC  1F      C NOTSD: RRA
150      20ED  1F      C          RRA
151      20EE  1F      C          RRA
152      20EF  1F      C          RRA
153      20F0  E6 02    C          AND    02H
154      20F2  B0      C          OR     B          ;SEGMENT CODE OF SIGN AND DATA
155      20F3  DD 77 00  C          LD    (IX+0),A
156      20F6  DD 23    C          INC    IX          ;TO DIGIT 5
157      20F8  16 00    C          LD    D,00H      ;CHECK BLANK STATUS
158      20FA  3E 20    C          LD    A,20H
159      20FC  B8      C          CP     B
160      20FD  30 01    C          JR     NC,CHKBKD
161      20FF  14      C          INC    D
162      2100  FD 7E 00  C CHKBKD: LD    A,(IY+0)    ;TRANSFER DATA TO DIGIT 5
163      2103  E6 0F    C          AND    0FH
164      2105  47      C          LD    B,A          ;SAVE DATA FOR CHECK BLANK STATUS
165      2106  AF      C          XOR    A
166      2107  BA      C          CP     D
167      2108  20 04    C          JR     NZ,ONEBKD
168      210A  7B      C          LD    A,B          ;CHECK DIGIT VALUE

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169	210B	BA	C	CP	D	
170	210C	28 04	C	JR	Z,THBKD	
171	210E	78	C ONEBKD:	LD	A,B	
172	210F	CD 21C4	C	CALL	DTSEG	;CHANGE DATA TO SEGMENT CODE
173	2112	DD 77 00	C THBKD:	LD	(IX+0),A	
174	2115	DD 23	C	INC	IX	;TO DIGIT 6
175	2117	FD 2B	C	DEC	IY	;LOW BYTE DATA
176	2119	FD 7E 00	C	LD	A,(IY+0)	
177	211C	1F	C	RRA		
178	211D	1F	C	RRA		
179	211E	1F	C	RRA		
180	211F	1F	C	RRA		
181	2120	E6 0F	C	AND	OFH	
182	2122	47	C	LD	B,A	
183	2123	AF	C	XOR	A	;TRANSFER DATA TO DIGIT 6
184	2124	BA	C	CP	D	
185	2125	20 04	C	JR	NZ,NOTBKD	
186	2127	78	C	LD	A,B	
187	2128	BA	C	CP	D	
188	2129	28 04	C	JR	Z,DBKD	
189	212B	78	C NOTBKD:	LD	A,B	
190	212C	CD 21C4	C	CALL	DTSEG	
191	212F	DD 77 00	C DBKD:	LD	(IX+0),A	
192	2132	DD 23	C	INC	IX	;TO DIGIT 7
193	2134	FD 7E 00	C	LD	A,(IY+0)	
194	2137	E6 0F	C	AND	OFH	
195	2139	CD 21C4	C	CALL	DTSEG	
196	213C	DD 77 00	C	LD	(IX+0),A	
197	213F	CD 21B5	C	CALL	DECIPT	;DISPLAY DECIMAL POINT
198	2142	D1	C	POP	DE	
199	2143	Z1 185B	C	LD	HL,DATBUF	;TRANSFER DATBUF TO DISB
200	2146	ED A0	C	LDI		
201	2148	ED A0	C	LDI		
202	214A	ED A0	C	LDI		
203	214C	ED A0	C	LDI		
204	214E	D5	C	PUSH	DE	
205	214F	DD E1	C	POP	IX	
206	2151	C9	C	RET		
207	2152	FD 7E 00	C DATRAN:	LD	A,(IY+0)	;START AT DIGIT 0
208	2155	16 00	C	LD	D,00H	;SET ZERO BLANK CHECK
209	2157	BA	C	CP	D	
210	2158	C4 21C4	C	CALL	NZ,DTSEG	;NOT ZERO TO CALL DATA TO SEGMENT DECODE
211	215B	DD 77 00	C	LD	(IX+0),A	;TRANSFER DATA TO DIGIT 0
212	215E	DD 23	C	INC	IX	;TO DIGIT 1
213	2160	FD 2B	C	DEC	IY	;NEXT DATA
214	2162	AF	C	XOR	A	;CHECK ZERO BLANK DIGIT 1
215	2163	BA	C	CP	D	
216	2164	20 06	C	JR	NZ,NOTBKC	;DIGIT 0 NOT BLANK, NOT TO CHECK DIGIT 1
217	2166	FD 7E 00	C	LD	A,(IY+0)	
218	2169	BA	C	CP	D	
219	216A	2B 06	C	JR	Z,DBKC	;DIGIT 0 BLANK, DIGIT 1 = 0 TO DOUBLE BLANK
220	216C	FD 7E 00	C NOTBKC:	LD	A,(IY+0)	
221	216F	CD 21C4	C	CALL	DTSEG	;CALL DATA TO SEGMENT DECODE
222	2172	DD 77 00	C DBKC:	LD	(IX+0),A	;TRANSFER DATA TO DIGIT 1
223	2175	DD 23	C	INC	IX	;TO DIGIT 2
224	2177	FD 2B	C	DEC	IY	;NEXT DATA

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225 2179 FD 7E 00 C LD A,(IY+0)
226 217C CD 21C4 C CALL DTSEG ;DIGIT 2 CAN NOT BLANK
227 217F DD 77 00 C LD (IX+0),A ;TRANSFER DATA TO DIGIT 2
228 2182 DD 23 C INC IX ;TO DIGIT 3
229 2184 C9 C RET
230 2185 01 1879 C DECIPT: LD BC,CHDIS
231 2188 CD 26F8 C CALL CURRAG ;FIND CURRENT RANGE
232 218B EB C EX DE,HL
233 218C 21 299E C LD HL,RAGFMT ;RANGE FORMAT
234 218F 1A C LD A,(DE) ;LOAD CURRENT RANGE TO A
235 2190 4F C LD C,A ;FIND CURRENT RANGE FORMAT
236 2191 06 00 C LD B,00H
237 2193 09 C ADD HL,BC
238 2194 7E C LD A,(HL) ;LOAD CURRENT RANGE FORMAT
239 2195 E6 0F C AND 0FH
240 2197 CB C RET Z ;NO DECIMAL POINT
241 2198 FE 01 C CP 01H
242 219A 20 06 C JR NZ,DETRD ;DECIMAL AT THIRD DIGIT
243 219C 21 185D C LD HL,DATBUF+2 ;DECIMAL AT SECOND DIGIT
244 219F CB F6 C SET 6,(HL)
245 21A1 C9 C RET
246 21A2 FE 02 C DETRD: CP 02H
247 21A4 20 0C C JR NZ,DEFOR
248 21A6 21 185C C LD HL,DATBUF+1
249 21A9 CB F6 C SET 6,(HL)
250 21AB 23 C INC HL ;SECOND DIGIT BLANK DISPLAY ZERO
251 21AC AF C XOR A
252 21AD BE C CP (HL)
253 21AE C0 C RET NZ
254 21AF 36 BD C LD (HL),OBDH
255 21B1 C9 C RET
256 21B2 21 185B C DEFOR: LD HL,DATBUF
257 21B5 CB F6 C SET 6,(HL)
258 21B7 23 C INC HL
259 21B8 AF C XOR A
260 21B9 BE C CP (HL)
261 21BA C0 C RET NZ
262 21BB 36 BD C LD (HL),OBDH
263 21BD 23 C INC HL
264 21BE AF C XOR A
265 21BF BE C CP (HL)
266 21C0 C0 C RET NZ
267 21C1 36 BD C LD (HL),OBDH
268 21C3 C9 C RET
269 21C4 4F C DTSEG: LD C,A ;TRANSFER DATA TO BC
270 21C5 06 00 C LD B,00H
271 21C7 21 298B C LD HL,SEGCD ;SEGMENT CODE ADDRESS OF 0 AT SEGCD
272 21CA 09 C ADD HL,BC ;SEGMENT CODE ADDRESS OF DATA AT HL
273 21CB 7E C LD A,(HL) ;LOAD SEGMENT CODE TO A
274 21CC 16 01 C LD D,01H ;SET DATA AFTER NOT BLANK ZERO
275 21CE C9 C RET
276 C INCLUDE B:HLTHLD
277 C ;*****
278 C ;* HIGH LIMIT HOLD DISPLAY *
279 C ;*****
280 C ;DISPLAY CHANNEL AND HIGH LIMIT DATA IN HOLD MODE

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337 C ;*****
338 C ;* CHANNEL SET DISPLAY *
339 C ;*****
340 C ;DISPLAY SELECT CHANNEL IN HOLD AND PROGRAM MODE
341 C ;
342 2233 FD 21 1817 C CHNSET: LD IY,BEFEN+2 ;DISPLAY FROM DATA BEFORE ENTER
343 2237 CD 20C3 C CALL CHSIY ;TRANSFER KEY CHANNEL TO DISPLAY BUFFER
344 223A AF C XOR A ;THE OTHER DIGIT BLANK
345 223B 06 04 C LD B,04H ;4 DIGIT
346 223D DD 77 00 C NTTRAN: LD (IX+0),A
347 2240 DD 23 C INC IX
348 2242 10 F9 C DJNZ NTTRAN
349 2244 3A 1813 C LD A,(OPFUNC) ;CHECK OPERATED MODE
350 2247 CB 77 C BIT 6,A
351 2249 28 06 C JR Z,HLDM ;TO SHOW LAMP HOLD MODE
352 224B 3E 42 C LD A,42H ;SHOW HOLD AND PROGRAM LAMP
353 224D DD 77 00 C LD (IX+0),A
354 2250 C9 C RET
355 2251 3E 40 C HLDMD: LD A,40H ;SHOW HOLD LAMP
356 2253 DD 77 00 C LD (IX+0),A
357 2256 C9 C RET
358 C INCLUDE B:TIMHLD
359 C ;*****
360 C ;* TIME HOLD DISPLAY *
361 C ;*****
362 C ;DISPLAY TIME IN HOLD MODE
363 C ;
364 2257 CD 2267 C TIMHLD:: CALL BLK3D ;BLANK 3 DIGIT,DIGIT 0-2
365 225A FD 21 1822 C LD IY,TIMED+5 ;DISPLAY HOURS AND MINUTE
366 225E CD 2276 C CALL TMTRN ;TRANSFER TIME FORMAT
367 2261 3E 41 C LD A,41H ;DISPLAY HOLD AND TIME LAMP
368 2263 DD 77 00 C LD (IX+0),A
369 2266 C9 C RET
370 2267 DD 21 1802 C BLK3D: LD IX,DISB ;LOAD DISPLAY BUFFER ADDRESS TO IX
371 226B 06 03 C LD B,03H ;SET BLANK COUNTER
372 226D AF C XOR A ;SEND BLANK
373 226E DD 77 00 C NXTRN: LD (IX+0),A
374 2271 DD 23 C INC IX ;NEXT POINTER
375 2273 10 F9 C DJNZ NXTRN
376 2275 C9 C RET
377 2276 CD 2283 C TMTRN: CALL B2TRN ;TWO BYTE TRANSFER
378 2279 AF C XOR A ;SEND BLANK
379 227A DD 77 00 C LD (IX+0),A
380 227D DD 23 C INC IX ;NEXT POINTER
381 227F CD 2283 C CALL B2TRN
382 2282 C9 C RET
383 2283 FD 7E 00 C B2TRN: LD A,(IY+0) ;TRANSFER DATA 2 BYTE
384 2286 CD 21C4 C CALL DTSEG ;DATA TO SEGMENT DECODE
385 2289 DD 77 00 C LD (IX+0),A ;TRANSFER
386 228C DD 23 C INC IX ;NEXT BYTE
387 228E FD 2B C DEC IY
388 2290 FD 7E 00 C LD A,(IY+0)
389 2293 CD 21C4 C CALL DTSEG
390 2296 DD 77 00 C LD (IX+0),A
391 2299 DD 23 C INC IX
392 229B FD 2B C DEC IY

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393 229D C9 C RET
394 C INCLUDE B:DATHLD
395 C
396 C ;*****
397 C ;* DATE HOLD DISPLAY *
398 C ;*****
399 C ;DISPLAY DATE IN HOLD MODE
400 C ;
401 229E FD 21 1824 C DATHLD: LD IY,TIMED+7 ;TRANSFER START AT HIGH BYTE DATE
402 22A2 DD 21 1802 C LD IX,DISB ;LOAD DISPLAY BUFFER ADDRESS TO IX
403 22A6 CD 2283 C CALL B2TRN ;TWO BYTE TRANSFER
404 22A9 AF C XOR A ;SEND BLANK
405 22AA DD 77 00 C LD (IX+0),A
406 22AD DD 23 C INC IX ;NEXT BUFFER
407 22AF FD 21 1826 C LD IY,TIMED+9 ;HIGH BYTE MONTH
408 22B3 CD 2283 C CALL B2TRN
409 22B6 AF C XOR A
410 22B7 DD 77 00 C LD (IX+0),A
411 22BA DD 23 C INC IX
412 22BC FD 21 1828 C LD IY,TIMED+11 ;HIGH BYTE YEAR
413 22C0 CD 2283 C CALL B2TRN
414 22C3 3E C0 C LD A,COCH ;DISPLAY HOLD AND DATE LAMP
415 22C5 DD 77 00 C LD (IX+0),A
416 22C8 C9 C RET
417 C -INCLUDE B:INVHLD
418 C ;*****
419 C ;* INTERVAL PRINT TIME HOLD DISPLAY *
420 C ;*****
421 C ;DISPLAY INTERVAL PRINT TIME IN HOLD MODE
422 C ;
423 22C9 CD 2267 C INVHLD: CALL BLK3D ;BLANK 3 DIGIT, DIGIT 0-2
424 22CC FD 21 1880 C LD IY,PRTM+3 ;HIGH BYTE OF HOUR
425 22D0 CD 2276 C CALL TMTRN ;TRANSFER TIME FORMAT
426 22D3 3E 44 C LD A,44H ;DISPLAY HOLD AND INTV LAMP
427 22D5 DD 77 00 C LD (IX+0),A
428 22D8 C9 C RET
429 C INCLUDE B:PROGM
430 C ;*****
431 C ;* NO FUNCTION PROGRAM DISPLAY *
432 C ;*****
433 C ;DISPLAY FIX FORMAT "- PROG -"
434 C ;
435 22D9 DD 21 1802 C PROGM: LD IX,DISB ;LOAD DISPLAY BUFFER ADDRESS TO IX
436 22DD FD 21 2996 C LD IY,PROG ;"- PROG -" TABLE AT PROG
437 22E1 06 08 C LD B,08H ;SET COUNTER
438 22E3 FD 7E 00 C NTRN: LD A,(IY+0) ;TRANSFER
439 22E6 DD 77 00 C LD (IX+0),A
440 22E9 DD 23 C INC IX
441 22EB FD 23 C INC IY
442 22ED 10 F4 C DJNZ NTRN
443 22EF 3E 42 C LD A,42H ;DISPLAY HOLD AND PROGRAM LAMP
444 22F1 DD 77 00 C LD (IX+0),A
445 22F4 C9 C RET
446 C INCLUDE B:LTPRO
447 C ;*****
448 C ;* LIMIT PROGRAM DISPLAY *

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449          C ;*****
450          C ;DISPLAY CHANNEL AND HIGH LIMIT DATA IN PROGRAM MODE
451          C ;DISPLAY CHANNEL AND LOW LIMIT DATA IN POGRAM MODE
452          C ;
453 22F5 CD 2307 C HLTPRO: CALL LTPRO          ;DISPLAY CHANNEL AND LIMIT DATA
454 22F8 3E 62 C          LD A,62H          ;DISPLAY HOLD, PROGRAM AND HIGH LIMIT LAMP
455 22FA DD 77 00 C          LD (IX+0),A
456 22FD C9 C          RET
457 22FE CD 2307 C LLTPRO: CALL LTPRO
458 2301 3E 52 C          LD A,52H          ;DISPLAY HOLD, PROGRAM AND LOW LIMIT LAMP
459 2303 DD 77 00 C          LD (IX+0),A
460 2306 C9 C          RET
461 2307 CD 20BF C LTPRO: CALL CHANNL          ;TRANSFER CHANNEL TO DISPLAY BUFFER
462 230A DD E5 C          PUSH IX          ;SAVE DATA IN DATBUF BEFORE TO DISBUF
463 230C DD 21 185B C          LD IX,DATBUF
464 2310 3A 181B C          LD A,(BEFEN+6)          ;SIGN DATA IN BEFEN+6
465 2313 47 C          LD B,A
466 2314 3A 181B C          LD A,(BEFEN+3)
467 2317 FE 01 C          CP 01H
468 2319 28 21 C          JR Z,HONE
469 231B AF C          XOR A
470 231C B0 C          OR B
471 231D DD 77 00 C          LD (IX+0),A
472 2320 DD 23 C          INC IX          ;NEXT POINTER
473 2322 FD 21 1817 C          LD IY,BEFEN+2          ;DISPLAY FROM DATA BEFORE ENTER
474 2326 CD 2152 C          CALL DATRAM          ;TRANSFER DATA
475 2329 CD 2185 C DECPY: CALL DECIPT          ;DECIMAL POINT
476 232C D1 C          POP DE
477 232D 21 185B C          LD HL,DATBUF
478 2330 ED A0 C          LDI
479 2332 ED A0 C          LDI
480 2334 ED A0 C          LDI
481 2336 ED A0 C          LDI
482 2338 D5 C          PUSH DE
483 2339 DD E1 C          POP IX
484 233B C9 C          RET
485 233C 3E 30 C HONE: LD A,30H
486 233E B0 C          OR B
487 233F DD 77 00 C          LD (IX+0),A
488 2342 DD 23 C          INC IX
489 2344 FD 21 1817 C          LD IY,BEFEN+2
490 2348 FD 7E 00 C          LD A,(IY+0)
491 234B CD 21C4 C          CALL DTSEG
492 234E DD 77 00 C          LD (IX+0),A
493 2351 DD 23 C          INC IX
494 2353 FD 2B C          DEC IY
495 2355 FD 7E 00 C          LD A,(IY+0)
496 2358 CD 21C4 C          CALL DTSEG
497 235B DD 77 00 C          LD (IX+0),A
498 235E DD 23 C          INC IX
499 2360 FD 2B C          DEC IY
500 2362 FD 7E 00 C          LD A,(IY+0)
501 2365 CD 21C4 C          CALL DTSEG
502 2368 DD 77 00 C          LD (IX+0),A
503 236B 18 BC C          JR DECPY
504          C          INCLUDE B:RAGPRO

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505      C ;*****
506      C ;*      RANGE PROGRAM DISPLAY      *
507      C ;*****
508      C ;DISPLAY CHANNEL AND RANGE IN PROGRAM MODE
509      C ;
510      236D   CD 20BF   C RAGPRO: CALL  CHANNL      ;TRANSFER CHANNEL TO DISPLAY DATA
511      2370   DD 77 00   C          LD    (IX+0),A      ;SEND TWO BLANK
512      2373   DD 23     C          INC    IX
513      2375   DD 77 00   C          LD    (IX+0),A
514      2378   DD 23     C          INC    IX
515      237A   3A 1816   C          LD    A,(BEFEN+1)    ;CHECK ZERO BLANK
516      237D   FE 00     C          CP    00H
517      237F   28 03     C          JR    Z,SENDB      ;SEND BLANK
518      2381   CD 21C4   C          CALL  DTSEG      ;DATA TO SEGMENT DECODE
519      2384   DD 77 00   C SENDB: LD    (IX+0),A
520      2387   DD 23     C          INC    IX
521      2389   3A 1815   C          LD    A,(BEFEN)      ;TRANSFER LOW BYTE RANGE
522      238C   CD 21C4   C          CALL  DTSEG
523      238F   DD 77 00   C          LD    (IX+0),A
524      2392   DD 23     C          INC    IX
525      2394   3E 4A     C          LD    A,4AH      ;DISPLAY HOLD, PRO AND RANGE LAMP
526      2396   DD 77 00   C          LD    (IX+0),A
527      2399   C9       C          RET
528      C          INCLUDE B:TIMPRO
529      C ;*****
530      C ;*      TIME PROGRAM DISPLAY      *
531      C ;*****
532      C ;DISPLAY TIME IN PROGRAM MODE
533      C ;DISPLAY INTERVAL PRINT TIME IN PROGRAM MODE
534      C ;
535      239A   CD 23AC   C TIMPRO: CALL  DISTM      ;DISPLAY TIME
536      239D   3E 43     C          LD    A,43H      ;DISPLAY HOLD, PROGRAM AND TIME LAMP
537      239F   DD 77 00   C          LD    (IX+0),A
538      23A2   C9       C          RET
539      23A3   CD 23AC   C INVPRO: CALL  DISTM
540      23A6   3E 46     C          LD    A,46H      ;DISPLAY HOLD, PROGRAM AND INTV LAMP
541      23A8   DD 77 00   C          LD    (IX+0),A
542      23AB   C9       C          RET
543      23AC   CD 2267   C DISTM: CALL  BLK3D      ;BLANK 3 DIGIT, DIGIT 0-2
544      23AF   FD 21 1818 C          LD    IY,BEFEN+3    ;DISPLAY FROM DATA BEFORE ENTER
545      23B3   CD 2276   C          CALL  TMTRN      ;TRANSFER TIME FORMAT
546      23B6   C9       C          RET
547      C          INCLUDE B:DATPRO
548      C ;*****
549      C ;*      DATE PROGRAM DISPLAY      *
550      C ;*****
551      C ;DISPLAY DATE IN PROGRAM MODE
552      C ;
553      23B7   FD 21 181A C DATPRO: LD    IY,BEFEN+5    ;DISPLAY FROM DATA BEFORE ENTER
554      23BB   DD 21 1802 C          LD    IX,DISB      ;LOAD DISPLAY BUFFER ADDRESS TO IX
555      23BF   CD 2276   C          CALL  TMTRN      ;TRANSFER TIME FORMAT
556      23C2   AF       C          XOR    A      ;SEND BLANK
557      23C3   DD 77 00   C          LD    (IX+0),A
558      23C6   DD 23     C          INC    IX      ;NEXT BUFFER
559      23C8   CD 2283   C          CALL  B2TRN      ;TRANSFER DATA 2 BYTE
560      23CB   3E C2     C          LD    A,0C2H      ;DISPLAY HOLD, PROGRAM AND DATE LAMP

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561 23CD DD 77 00 C LD (IX+0),A
562 23D0 C9 C RET
563 C INCLUDE B:ADINT
564 C ;*****
565 C ;* A/D INTERRUPT *
566 C ;*****
567 C ;THIS PROGRAM IS INTERRUPT PROGRAM
568 C ;
569 23D1 F5 C ADINT:: PUSH AF ;SAVE REGISTER
570 23D2 C5 C PUSH BC
571 23D3 D5 C PUSH DE
572 23D4 E5 C PUSH HL
573 23D5 DD E5 C PUSH IX
574 23D7 FD E5 C PUSH IY
575 23D9 21 1853 C LD HL,ADDAT ;READ DATA FROM A/D
576 23DC DB 80 C IN A,(PIODA)
577 23DE 77 C LD (HL),A
578 23DF 23 C INC HL
579 23E0 DB 81 C IN A,(PIODB)
580 23E2 77 C LD (HL),A
581 23E3 3E 01 C LD A,01H ;SET STATUS
582 23E5 32 1831 C LD (ADINT1),A
583 23E8 FD E1 C POP IY
584 23EA DD E1 C POP IX
585 23EC E1 C POP HL
586 23ED D1 C POP DE
587 23EE C1 C POP BC
588 23EF F1 C POP AF
589 23F0 FB C EI
590 23F1 ED 4D C RETI
591 C INCLUDE B:SERINT
592 C ;*****
593 C ;* SERIAL COMMUNICATION INTERRUPT *
594 C ;*****
595 C ;THIS PROGRAM IS INTERRUPT PROGRAM
596 C ;
597 23F3 F5 C SERINT:: PUSH AF ;SAVE REGISTER
598 23F4 C5 C PUSH BC
599 23F5 D5 C PUSH DE
600 23F6 E5 C PUSH HL
601 23F7 DD E5 C PUSH IX
602 23F9 FD E5 C PUSH IY
603 23FB 3E 9F C LD A,9FH
604 23FD D3 42 C OUT (CTC2),A
605 23FF 3E 02 C LD A,02H
606 2401 D3 42 C OUT (CTC2),A
607 2403 DB F8 C IN A,(DB251) ;CHECK ENQUIRY DATA
608 2405 FE 44 C CP 44H
609 2407 20 10 C JR NZ,EPRO ;CHECK ENQUIRY PROGRAM DATA
610 2409 3E 01 C LD A,01H ;SET SERIAL COMM. COMMAND
611 240B 32 1830 C LD (SERIN),A
612 240E FD E1 C OUTINT: POP IY
613 2410 DD E1 C POP IX
614 2412 E1 C POP HL
615 2413 D1 C POP DE
616 2414 C1 C POP BC

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617 2415 F1 C POP AF
618 2416 FB C EI
619 2417 ED 4D C RETI
620 2419 FE 50 C EPRD: CP 50H
621 241B 20 07 C JR NZ,SNDNAC ;TO SEND NON ACKNOWLEDGE
622 241D 3E 02 C LD A,02H
623 241F 32 1830 C LD (SERIN),A
624 2422 18 EA C JR OUTINT
625 2424 16 4E C SNDNAC: LD D,4EH ;SEND NON ACKNOWLEDGE
626 2426 CD 0000* C CALL TX##
627 2429 18 E3 C JR OUTINT
628 C INCLUDE B:SCNINT
629 C ;*****
630 C ;* SCAN KEYBOARD AND DISPLAY INTERRUPT *
631 C ;*****
632 C ;THIS PROGRAM IS INTERRUPT PROGRAM
633 C ;
634 242B F5 C SCNINT:: PUSH AF ;SAVE REGISTER
635 242C C5 C PUSH BC
636 242D D5 C PUSH DE
637 242E E5 C PUSH HL
638 242F DD E5 C PUSH IX
639 2431 FD E5 C PUSH IY
640 2433 CD 2441 C CALL SCANDIS ;SCAN KEYBOARD AND DISPLAY
641 2436 FD E1 C POP IY
642 2438 DD E1 C POP IX
643 243A E1 C POP HL
644 243B D1 C POP DE
645 243C C1 C POP BC
646 243D F1 C POP AF
647 243E FB C EI
648 243F ED 4D C RETI
649 C INCLUDE B:SCANDIS
650 C ;*****
651 C ;* SCAN KEYBOARD AND DISPLAY *
652 C ;*****
653 C ;DISPLAY NEXT DIGIT
654 C ;SCAN KEYBOARD IF (DIGIT) < 06H
655 C ;(DIGIT) = 06H TO KEYBOARD OPERATION
656 C ;(DIGIT) = 07H TO CHECK TIME
657 C ;
658 2441 CD 2455 C SCANDIS: CALL DISPLAY ;DISPLAY NEXT DIGIT
659 2444 3A 1801 C LD A,(DIGIT) ;CHECK DIGIT
660 2447 FE 06 C CP 06H
661 2449 DA 2477 C JP C,SCAN ;TO SCAN KEY BOARD IF (DIGIT) < 06H
662 244C CA 249E C JP Z,KEYOP ;TO KEY OPERATION IF (DIGIT) = 06H
663 244F FE 07 C CP 07H
664 2451 CA 24CE C JP Z,RUNTM ;TO CHECK RUN TIME FOR PRINT AND CHANGE CHANNEL
665 2454 C9 C RET
666 C INCLUDE B:DISPLAY
667 C ;*****
668 C ;* DISPLAY NEXT DIGIT *
669 C ;*****
670 C ;INCREMENT (DIGIT) AND SEGMENT POINTER (DISB)
671 C ;RESET TO ZERO AND SET SEGMENT POINTER IF (DIGIT) > 08H
672 C ;OUT DIGIT AND SEGMENT CODE

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673                                     C ;
674 2455 DD 2A 1876 C DISPLAY: LD IX, (CURBUF)
675 2459 3A 1801 C LD A, (DIGIT) ;DISPLAY DIGIT
676 245C 3C C INC A ;CHANGE THE NEXT DIGIT
677 245D FE 09 C CP 09H ;THERE ARE 9 DIGIT
678 245F 38 05 C JR C, NEXTD
679 2461 AF C XOR A ;RESET THE NEXT DIGIT
680 2462 DD 21 1801 C LD IX, DISB-01H ;SET SEGMENT POINTER
681 2466 32 1801 C NEXTD: LD (DIGIT), A
682 2469 DD 23 C INC IX ;CHANGE THE NEXT POINTER
683 246B D3 DA C OUT (PORTC3), A ;OUT DIGIT DISPLAY
684 246D DD 7E 00 C LD A, (IX+00H)
685 2470 D3 D9 C OUT (PORTB3), A ;OUT SEGMENT CODE
686 2472 DD 22 1876 C LD (CURBUF), IX
687 2476 C9 C RET
688 C INCLUDE B:SCAN
689 C ;*****
690 C ;* SCAN KEYBOARD *
691 C ;*****
692 C ;SCAN KEYBOARD 1 COLUMN
693 C ;(KPRESS) IS THE PRESSED KEY
694 C ;
695 2477 0E 00 C SCAN: LD C, 00H ;REGISTER C IS KEY COUNTER
696 2479 3A 1801 C LD A, (DIGIT) ;(DIGIT) > 0 LOAD (KCOUNT) TO REGISTER C
697 247C FE 00 C CP 00H
698 247E 28 04 C JR Z, RDKEY
699 2480 3A 180B C LD A, (KCOUNT)
700 2483 4F C LD C, A
701 2484 06 04 C RDKEY: LD B, 04H ;THERE ARE 4 ROW IN COLUMN
702 2486 DB DB C IN A, (PORTA3) ;KEY INPUT DATA
703 2488 57 C LD D, A
704 2489 0C C KROW: INC C
705 248A CB 1A C RR D ;CHECK ROW
706 248C 38 09 C JR C, NOKEY
707 248E 3E 05 C LD A, 05H ;SET DEBOUNCE TIME
708 2490 32 180C C LD (KDBOUC), A
709 2493 79 C LD A, C ;SAVE PRESSED KEY POSITION
710 2494 32 180D C LD (KPRESS), A
711 2497 10 F0 C NOKEY: DJNZ KROW
712 2499 79 C LD A, C ;LOAD REGISTER C TO (KCOUNT)
713 249A 32 180B C LD (KCOUNT), A
714 249D C9 C RET
715 C INCLUDE B:KEYOP
716 C ;*****
717 C ;* KEY OPERATION *
718 C ;*****
719 C ;CHECK DEBOUNCE TIME IF EQUAL 00 ,KEY RELEASE O.K.
720 C ;START DECREASE DEBOUNCE TIME WHEN KEY RELEASE
721 C ;KEY FUNCTION OPERATE AFTER KEY PRESSED
722 C ;
723 249E 3A 180C C KEYOP: LD A, (KDBOUC) ;CHECK DEBOUNCE TIME
724 24A1 FE 00 C CP 00H
725 24A3 2B 17 C JR Z, REOLK ;IF EQUAL 00 TO RESET OLD KEY
726 24A5 3A 180D C LD A, (KPRESS) ;CHECK PRESSED KEY
727 24A8 FE 00 C CP 00H
728 24AA 2B 16 C JR Z, DEKDB ;KEY RELEASE TO DECREASE DEBOUNCE TIME

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729 24AC 3A 1811 C LD A,(OLDK) ;CHECK IT OLD KEY OR NOT
730 24AF FE 00 C CP 00H
731 24B1 20 16 C JR NZ,REKPR ;OLD KEY TO RESET PRESSED KEY
732 24B3 3C C INC A ;SET OLD KEY
733 24B4 32 1811 C LD (OLDK),A
734 24B7 CD 253B C CALL KEYSR ;NEW KEY OPERATION
735 24BA 18 0D C JR REKPR ;TO RESET PRESSED KEY
736 24BC AF C REOLK: XOR A ;RESET OLD KEY
737 24BD 32 1811 C LD (OLDK),A
738 24C0 18 07 C JR REKPR ;TO RESET PRESSED KEY
739 24C2 3A 180C C DEKDB: LD A,(KDBOUC) ;DECREASE DEBOUNCE TIME
740 24C5 3D C DEC A
741 24C6 32 180C C LD (KDBOUC),A
742 24C9 AF C REKPR: XOR A ;RESET PRESSED KEY
743 24CA 32 180D C LD (KPRESS),A
744 24CD C9 C RET
745 C INCLUDE B:RUNTM
746 C ;*****
747 C ;* CHECK RUN TIME *
748 C ;*****
749 C ;CHECK DISPLAY CHANNEL SCAN TIME AND SET COMMAND
750 C ;CHECK PRINT TIME INTERVAL AND SET COMMAND
751 C ;
752 24CE 3A 1813 C RUNTM: LD A,(OPFUNC) ;CHECK IN RUN MODE ONLY
753 24D1 CB 7F C BIT 7,A
754 24D3 C0 C RET NZ
755 24D4 3A 180E C LD A,(RDTM) ;CHECK AFTER 48 TIME INTERRUPT
756 24D7 3C C INC A
757 24D8 32 180E C LD (RDTM),A
758 24DB FE 30 C CP 30H
759 24DD D8 C RET C
760 24DE AF C XOR A
761 24DF 32 180E C LD (RDTM),A
762 24E2 3A 182E C LD A,(LASTM) ;COMPARE SEC TO DECREASE CHANNEL DISPLAY TIME
763 24E5 47 C LD B,A
764 24E6 3A 181D C LD A,(TIMED)
765 24E9 E6 0F C AND 0FH
766 24EB 32 182E C LD (LASTM),A
767 24EE F6 10 C OR 10H
768 24F0 90 C SUB B
769 24F1 27 C DAA
770 24F2 E6 0F C AND 0FH
771 24F4 47 C LD B,A
772 24F5 3A 1829 C LD A,(CDISTM)
773 24F8 90 C SUB B
774 24F9 38 04 C JR C,SCOMD
775 24FB 32 1829 C LD (CDISTM),A ;RESAVE CDISTM
776 24FE C9 C RET
777 24FF 3E 05 C SCOMD: LD A,CHGCH ;RESET CHANGE CHANNEL TIME
778 2501 32 1829 C LD (CDISTM),A
779 2504 3E 01 C LD A,01H ;SET COMMAND
780 2506 32 180F C LD (CHTM),A
781 2509 3A 182F C LD A,(LINTV) ;COMPARE MINUTE TO DECREMENT INTERVAL TIME
782 250C 47 C LD B,A
783 250D 3A 181F C LD A,(TIMED+2)
784 2510 E6 0F C AND 0FH

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785 2512 32 182F C LD (LINTV),A
786 2515 F6 10 C OR 10H
787 2517 90 C SUB B
788 2518 27 C DAA
789 2519 E6 0F C AND 0FH
790 251B 5F C LD E,A
791 251C 16 00 C LD D,00H
792 251E 2A 182A C LD HL,(PTMDEC)
793 2521 37 C SCF
794 2522 3F C CCF
795 2523 ED 52 C SBC HL,DE
796 2525 28 04 C JR Z,SINCOM
797 2527 22 182A C LD (PTMDEC),HL ;RESAVE PTMDEC
798 252A C9 C RET
799 252B 11 182A C SINCOM: LD DE,PTMDEC ;RESET PTMDEC
800 252E 21 182C C LD HL,PTMDEC+2
801 2531 ED A0 C LDI
802 2533 ED A0 C LDI
803 2535 3E 01 C LD A,01H ;SET COMMAND
804 2537 32 1810 C LD (INTVTM),A
805 253A C9 C RET
806 C INCLUDE B:KEYGP
807 C ;*****
808 C ;* KEY GROUP *
809 C ;*****
810 C ;KEYBOARD DEVIDE TO 5 GROUP
811 C ;RESET ALARM,ENTER,MODE,FUNCTION,NUMBER
812 C ;
813 253B 3A 180D C KEYGP: LD A,(KPRESS) ;FIND PRESSED KEY CODE
814 253E 21 2972 C LD HL,KMAP ;POSITION OF KEY CODE ARE KMAP
815 2541 16 00 C LD D,00H
816 2543 5F C LD E,A
817 2544 19 C ADD HL,DE
818 2545 7E C LD A,(HL)
819 2546 32 1812 C LD (LASTK),A ;SAVE KEY CODE AT LASTK
820 2549 CB 0F C RRC A ;FIND ADRESS OF SUBROUTINE
821 254B CB 0F C RRC A
822 254D CB 0F C RRC A
823 254F E6 0E C AND 0EH
824 2551 21 2920 C LD HL,KGRP ;ADDRESS OF SUBROUTINE ARE KGRP
825 2554 06 00 C LD B,00H
826 2556 4F C LD C,A
827 2557 09 C ADD HL,BC
828 2558 5E C LD E,(HL) ;TRANSFER DATA IN KGRP TO REGISTER HL
829 2559 23 C INC HL
830 255A 56 C LD D,(HL)
831 255B EB C EX DE,HL
832 255C E9 C JP (HL) ;JUMP TO GROUP SUBROUTINE
833 C INCLUDE B:REALM
834 C ;*****
835 C ;* RESET ALARM KEY *
836 C ;*****
837 C ;SEND OFF ALARM CODE TO ALARM PORT
838 C ;
839 255D AF C REALM: XOR A ;OFF ALARM CODE = 00H
840 255E D3 CA C OUT (PORTC2),A

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841 2560 C9 C RET
842 C INCLUDE B:ENTER
843 C ;*****
844 C ;* ENTER KEY *
845 C ;*****
846 C ;SEND DATA FROM KEYBOARD TO OPERATE BUFFER
847 C ;IN HOLD MODE ENTER CHANNEL NUMBER ACTIVE ONLY
848 C ;
849 2561 21 1813 C ENTER: LD HL,DPFUNC ;OPERATED FUNCTION IS AT OPFUNC
850 2564 CB 7E C BIT 7,(HL) ;RUN MODE TO RETURN
851 2566 C8 C RET Z
852 2567 CB 76 C BIT 6,(HL) ;PROGRAM MODE TO PROGRAM FUNCTION
853 2569 20 10 C JR NZ,PROF
854 256B 7E C LD A,(HL) ;HOLD MODE CHECK CHANNEL FUNCTION
855 256C E6 30 C AND 30H
856 256E FE 20 C CP 20H
857 2570 20 03 C JR NZ,SENH ;NOT CHANNEL FUNCTION SET TO NO FUNCTION HOLD
858 2572 CD 2707 C CALL CHNEN ;CALL CHANNEL ENTER
859 2575 3E 80 C SENH: LD A,80H ;SET TO NO FUNCTION HOLD
860 2577 32 1813 C LD (OPFUNC),A
861 257A C9 C RET
862 257B CD 25F4 C PROF: CALL PROFNC ;CALL PROGRAM FUNCTION
863 257E C9 C RET
864 C INCLUDE B:MODEK
865 C ;*****
866 C ;* MODE KEY *
867 C ;*****
868 C ;SET OPERATED FUNCTION TO PRESSED KEY MODE
869 C ;IN RUN MODE PROGRAM KEY IS NOT ACTIVE
870 C ;
871 257F 3A 1832 C MODEK: LD A,(NOTPRG) ;CHECK NOT PROGRAM CHANNEL
872 2582 FE 01 C CP 01H
873 2584 C8 C RET Z
874 2585 21 1813 C LD HL,OPFUNC ;LOAD OPERATED FUNCTION ADDRESS FOR COMPARE
875 2588 3A 1812 C LD A,(LASTK) ;CHECK THE PRESSED KEY ARE HOLD OR PROGRAM KEY
876 258B E6 0F C AND 0FH
877 258D 28 12 C JR Z,HOLDK ;HOLD KEY TO CHECK OPERATED FUNCTION
878 258F CB 7E C BIT 7,(HL) ;CHECK IT IN RUN MODE OR NOT
879 2591 C8 C RET Z ;RUN MODE TO RETURN
880 2592 3E 01 C LD A,01H ;SET PRINT MODE STATE
881 2594 32 1814 C LD (PMOTM),A
882 2597 CB 76 C BIT 6,(HL) ;CHECK IT IS PROGRAM OR HOLD MODE
883 2599 28 03 C JR Z,PRCD ;HOLD MODE TO SET PROGRAM CODE
884 259B 36 80 C HLCD: LD (HL),80H ;SET HOLD CODE
885 259D C9 C RET
886 259E 36 C0 C PRCD: LD (HL),0C0H ;SET PROGRAM MODE
887 25A0 C9 C RET
888 25A1 3E 01 C HOLDK: LD A,01H ;SET PRINT MODE STATE
889 25A3 32 1814 C LD (PMOTM),A
890 25A6 CB 7E C BIT 7,(HL) ;CHECK IT IS IN RUN MODE OR HOLD MODE
891 25A8 28 F1 C JR Z,HLCD ;IN RUN MODE TO SET HOLD CODE
892 25AA 36 00 C LD (HL),00H ;IN HOLD MODE SET RUN CODE
893 25AC CD 284D C CALL SETRUN
894 25AF C9 C RET
895 C INCLUDE B:FUNCK
896 C ;*****

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897          C ;*           FUNCTION KEY           *
898          C ;*****
899          C ;THERE ARE 8 FUNCTION KEY
900          C ;DATE,TIME,INTERVAL PRINT,CHANNEL,RANGE,HIGH LIMIT,LOW LIMIT,PRINT
901          C ;
902      25B0    21 1813  C FUNCJ: LD    HL,OPFUNC    ;CHECK OPERATED FUNCTION
903      25B3    CB 7E   C        BIT    7,(HL)
904      25B5    CB     C        RET    Z          ;RUN MODE TO RETURN
905      25B6    3A 1812  C        LD    A,(LASTK)    ;FIND ADDRESS OF SUBROUTINE
906      25B9    CB 17   C        RL    A
907      25BB    E6 0E   C        AND   0EH
908      25BD    CB 76   C        BIT    6,(HL)
909      25BF    28 02   C        JR    Z,FUNCJP
910      25C1    F6 10   C        OR    10H
911      25C3    21 292A  C FUNCJP: LD    HL,FUNMAP    ;ADDRESS OF SUBROUTINE ARE FUNMAP
912      25C6    06 00   C        LD    B,00H
913      25C8    4F     C        LD    C,A
914      25C9    09     C        ADD   HL,BC
915      25CA    5E     C        LD    E,(HL)      ;TRANSFER DATA IN FUNMAP TO REGISTER HL
916      25CB    23     C        INC   HL
917      25CC    56     C        LD    D,(HL)
918      25CD    EB     C        EX    DE,HL
919      25CE    E9     C        JP    (HL)      ;JUMP TO FUNCTION SUBROUTINE
920          C        INCLUDE B:DATAK
921          C ;*****
922          C ;*           DATA KEY           *
923          C ;*****
924          C ;THERE ARE 3 KIND OF DATA KEY
925          C ;NUMBER 0-9,PLUS/MINUS,CLEAR
926          C ;
927      25CF    21 1813  C DATAK: LD    HL,OPFUNC    ;CHECK OPERATED FUNCTION
928      25D2    CB 7E   C        BIT    7,(HL)
929      25D4    CB     C        RET    Z          ;RUN MODE TO RETURN
930      25D5    CB 76   C        BIT    6,(HL)
931      25D7    20 06   C        JR    NZ,DATAF    ;PROGRAM MODE TO DATA FUNCTION
932      25D9    7E     C        LD    A,(HL)
933      25DA    E6 30   C        AND   30H        ;HOLD MODE IF NOT CHANNEL FUNCTION TO RETURN
934      25DC    FE 20   C        CP    20H
935      25DE    C0     C        RET    NZ
936      25DF    3A 1812  C DATAF: LD    A,(LASTK)    ;LOAD THE PRESSED KEY CODE
937      25E2    FE 0A   C        CP    0AH
938      25E4    38 06   C        JR    C,CNUMB    ;PRESSED KEY < 0AH TO CALL NUMBER
939      25E6    20 08   C        JR    NZ,CCLR    ;PRESSED KEY > 0AH TO CALL CLEAR
940      25E8    CD 2903  C        CALL  MINUS      ;PRESSED KEY = 0AH CALL MINUS
941      25EB    C9     C        RET
942      25EC    CD 28F3  C CNUMB:  CALL  NUMB
943      25EF    C9     C        RET
944      25F0    CD 2915  C CCLR:   CALL  CLEAR
945      25F3    C9     C        RET
946          C        INCLUDE B:PROFNC
947          C ;*****
948          C ;*           PROGRAM FUNCTION ENTER       *
949          C ;*****
950          C ;FIND THE ADDRESS OF FUNCTION TO JUMP
951          C ;ENTER KEY DATA TO MATCH WITH OPERATED FUNCTION
952          C ;

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953 25F4 3A 1813 C PROFNC: LD A,(OPFUNC) ;MARK TO USE THE OPERATED FUNCTION ONLY
954 25F7 E6 30 C AND 30H
955 25F9 0F C RRCA ;FUNCTION CODE IS IN BIT 4 AND BIT 5
956 25FA 0F C RRCA
957 25FB 0F C RRCA
958 25FC 21 294A C LD HL,ENKFN ;ADDRESS OF SUBROUTINE FUNCTION ENTER ARE ENKFN
959 25FF 06 00 C LD B,00H
960 2601 4F C LD C,A
961 2602 09 C ADD HL,BC
962 2603 5E C LD E,(HL) ;TRANSFER DATA IN ENKFN TO REGISTER HL
963 2604 23 C INC HL
964 2605 56 C LD D,(HL)
965 2606 EB C EX DE,HL
966 2607 E9 C JP (HL) ;JUMP TO FUNCTION ENTER SUBROUTINE
967 C INCLUDE B:LIMEN
968 C ;*****
969 C ;* LIMIT FUNCTION ENTER *
970 C ;*****
971 C ;ENTER KEY DATA TO HIGH AND LOW LIMIT MEMORY
972 C ;
973 2608 3E 01 C LIMEN: LD A,01H ;SET CHECK PROGRAM CHANNEL STATUS
974 260A 32 185A C LD (CKNPG),A
975 260D 3A 1813 C LD A,(OPFUNC) ;CHECK HIGH LIMIT OR LOW LIMIT
976 2610 CB 5F C BIT 3,A
977 2612 20 4A C JR NZ,LOWLIM ;BIT 3 OF OPFUNC = 1 TO ENTER LOW LIMIT
978 2614 CB 57 C BIT 2,A
979 2616 28 3D C JR Z,CACLR ;BIT 2 OF OPFUNC = 0 TO CLEAR NUMBER BEFORE ENTER
980 2618 21 1A91 C LD HL,HLINT ;ADDRESS OF HIGH LIMIT CHANNEL 00H
981 261B 01 1879 C CACRAD: LD BC,CHDIS
982 261E CD 2692 C CALL CURADD ;FIND CURRENT DISPLAY ADDRESS
983 2621 11 1815 C LD DE,BEFEN ;TRANSFER NUMBER BEFORE ENTER TO LIMIT MEMORY
984 2624 1A C LD A,(DE)
985 2625 E6 0F C AND 0FH
986 2627 47 C LD B,A
987 2628 13 C INC DE
988 2629 1A C LD A,(DE)
989 262A 07 C RLCA
990 262B 07 C RLCA
991 262C 07 C RLCA
992 262D 07 C RLCA
993 262E E6 F0 C AND 0F0H
994 2630 B0 C OR B
995 2631 77 C LD (HL),A
996 2632 23 C INC HL
997 2633 13 C INC DE
998 2634 1A C LD A,(DE)
999 2635 E6 0F C AND 0FH
1000 2637 47 C LD B,A
1001 2638 13 C INC DE
1002 2639 1A C LD A,(DE)
1003 263A 0E 00 C LD C,00H
1004 263C FE 01 C CP 01H
1005 263E 20 01 C JR NZ,NOTONE
1006 2640 4F C LD C,A
1007 2641 3A 181B C NOTONE: LD A,(BEFEN+6) ;SIGN DATA IN BEFEN+6
1008 2644 B1 C OR C

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1009	2645	07	C	RLCA	
1010	2646	07	C	RLCA	
1011	2647	07	C	RLCA	
1012	2648	07	C	RLCA	
1013	2649	E6 F0	C	AND	0F0H
1014	264B	B0	C	OR	B
1015	264C	47	C	LD	B,A
1016	264D	7E	C	LD	A,(HL)
1017	264E	E6 80	C	AND	80H
1018	2650	B0	C	OR	B
1019	2651	77	C	LD	(HL),A
1020	2652	CD 2663	C	CALL	CHNUSE
1021	2655	CD 2915	C	CACLR: CALL	CLEAR ;CLEAR NUMBER BEFOR ENTER
1022	2658	3E C0	C	LD	A,0COH ;SET TO NO FUNCTION PROGRAM
1023	265A	32 1813	C	LD	(OPFUNC),A
1024	265D	C9	C	RET	
1025	265E	21 1C91	C	LOWLIM: LD	HL,LLIMT ;ADDRESS OF LOW LIMIT CHANNEL 00H
1026	2661	18 B8	C	JR	CACRAD
1027	2663	21 1C91	C	CHNUSE: LD	HL,LLIMT ;CHECK CURRENT HIGH LIMIT = LOW LIMIT
1028	2666	01 1879	C	LD	BC,CHDIS
1029	2669	CD 2692	C	CALL	CURADD
1030	266C	4E	C	LD	C,(HL)
1031	266D	23	C	INC	HL
1032	266E	7E	C	LD	A,(HL)
1033	266F	E6 3F	C	AND	3FH
1034	2671	47	C	LD	B,A
1035	2672	C5	C	PUSH	BC
1036	2673	21 1A91	C	LD	HL,HLIMT
1037	2676	01 1879	C	LD	BC,CHDIS
1038	2679	CD 2692	C	CALL	CURADD
1039	267C	5E	C	LD	E,(HL)
1040	267D	23	C	INC	HL
1041	267E	7E	C	LD	A,(HL)
1042	267F	E6 3F	C	AND	3FH
1043	2681	57	C	LD	D,A
1044	2682	EB	C	EX	DE,HL
1045	2683	C1	C	POP	BC
1046	2684	37	C	SCF	
1047	2685	3F	C	CCF	
1048	2686	ED 42	C	SBC	HL,BC
1049	2688	20 04	C	JR	NZ,REST ;RESET BIT IF HIGH LIMIT NOT EQUAL TOO LOW LIMIT
1050	268A	EB	C	EX	DE,HL
1051	268B	CB F6	C	SET	6,(HL) ;IF EQUAL SET BIT 6 OF HIGH LIMIT = 1
1052	268D	C9	C	RET	
1053	268E	EB	C	REST: EX	DE,HL
1054	268F	CB B6	C	RES	6,(HL)
1055	2691	C9	C	RET	
1056	2692	16 00	C	CURADD:: LD	D,00H ;FIND CURRENT DISPLAY ADDRESS
1057	2694	0A	C	LD	A,(BC)
1058	2695	5F	C	LD	E,A
1059	2696	CB 23	C	SLA	E
1060	2698	CB 12	C	RL	D
1061	269A	19	C	ADD	HL,DE
1062	269B	AF	C	XOR	A
1063	269C	3C	C	INC	A
1064	269D	C9	C	RET	

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1065      C          INCLUDE B:RGEN
1066      C ;*****
1067      C ;*      RANGE FUNCTION ENTER      *
1068      C ;*****
1069      C ;ENTER KEY DATA TO RANGE MEMORY
1070      C ;
1071      269E  3E 01  C RGEN:  LD    A,01H      ;SET CHECK PROGRAM CHANNEL STATUS
1072      26A0  32 185A C          LD    (CKNPG),A
1073      26A3  01 1879 C          LD    BC,CHDIS
1074      26A6  CD 26F8 C          CALL  CURRAG      ;FIND CURRENT DISPLAY ADDRESS
1075      26A9  3A 1816 C          LD    A,(BEFEN+1) ;CHECK KEY DATA
1076      26AC  FE 01  C          CP    01H
1077      26AE  3B 2D  C          JR    C,NORMDA    ;KEY DATA < 10 TO ENTER NORMAL DATA
1078      26B0  20 27  C          JR    NZ,NOTEN    ;KEY DATA > 20 TO NOT ENTER
1079      26B2  3A 1815 C          LD    A,(BEFEN)    ;CHECK KEY DATA > 15
1080      26B5  FE 06  C          CP    06H
1081      26B7  30 20  C          JR    NC,NOTEN    ;IF IT > 15 TO NOT ENTER
1082      26B9  C6 0A  C          ADD   A,0AH        ;CHANGE 10-15 TO A-F
1083      26BB  77      C ENRDA: LD    (HL),A      ;ENTER RANGE DATA
1084      26BC  FE 00  C          CP    00H        ;RANGE = 00H SET BIT 7 OF HIGH LIMIT = 1
1085      26BE  20 0B  C          JR    NZ,RSBIT
1086      26C0  CD 26E4 C          CALL  CURHLT      ;FIND CURRENT HIGH LIMIT TO SET BIT
1087      26C3  CB FE  C NTSET: SET   7,(HL)
1088      26C5  23      C          INC   HL
1089      26C6  23      C          INC   HL
1090      26C7  10 FA  C          DJNZ  NTSET
1091      26C9  1B 09  C          JR    NOFUNC
1092      26CB  CD 26E4 C RSBIT: CALL  CURHLT      ;RESET BIT
1093      26CE  CB BE  C NTRES: RES   7,(HL)
1094      26D0  23      C          INC   HL
1095      26D1  23      C          INC   HL
1096      26D2  10 FA  C          DJNZ  NTRES
1097      26D4  3E C0  C NOFUNC: LD    A,0COH    ;SET TO NO FUNCTION PROGRAM
1098      26D6  32 1813 C          LD    (OPFUNC),A
1099      26D9  CD 2915 C NOTEN: CALL  CLEAR      ;CLEAR NUMBER BEFORE ENTER
1100      26DC  C9      C          RET
1101      26DD  3A 1815 C NORMDA: LD    A,(BEFEN) ;ENTER NORMAL DATA
1102      26E0  E6 0F  C          AND   0FH
1103      26E2  1B D7  C          JR    ENRDA      ;TO ENTER RANGE DATA
1104      26E4  21 1A91 C CURHLT: LD    HL,HLIMIT ;FIND CURRENT HIGH LIMIT
1105      26E7  3A 1879 C          LD    A,(CHDIS)
1106      26EA  E6 F0  C          AND   0FOH
1107      26EC  16 00  C          LD    D,00H
1108      26EE  5F      C          LD    E,A
1109      26EF  CB 23  C          SLA   E
1110      26F1  CB 12  C          RL    D
1111      26F3  19      C          ADD   HL,DE
1112      26F4  23      C          INC   HL
1113      26F5  06 0F  C          LD    B,0FH
1114      26F7  C9      C          RET
1115      26F8  21 18B1 C CURRAG:: LD   HL,RANGE   ;ADDRESS OF RANGE CHANNEL 00H
1116      26FB  16 00  C          LD    D,00H        ;FIND CURRENT DISPLAY ADDRESS
1117      26FD  0A      C          LD    A,(BC)
1118      26FE  1F      C          RRA          ;CHANNEL IN BOARD ARE THE SAME RANGE
1119      26FF  1F      C          RRA
1120      2700  1F      C          RRA

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1121 2701 1F C RRA
1122 2702 E6 0F C AND OFH
1123 2704 5F C LD E,A
1124 2705 19 C ADD HL,DE
1125 2706 C9 C RET
1126 C INCLUDE B:CHNEN
1127 C ;*****
1128 C ;* CHANNEL FUNCTION ENTER *
1129 C ;*****
1130 C ;ENTER KEY DATA TO CHDIS
1131 C ;KEY DATA IS 1-240
1132 C ;ENTER KEY DATA TO CHDISD
1133 C ;
1134 2707 21 1817 C CHNEN: LD HL,BEFEN+2 ;CHECK THE THIRD DIGIT
1135 270A 7E C LD A,(HL)
1136 270B FE 02 C CP 02H
1137 270D 38 0D C JR C,BCDTH ;THIRD DIGIT < 2 TO CONVERT DATA
1138 270F C2 26D9 C JP NZ,NOTEN ;THIRD DIGIT > 2 TO NOT ENTER
1139 2712 2B C DEC HL ;CHECK THE SECOND DIGIT
1140 2713 7E C LD A,(HL)
1141 2714 FE 04 C CP 04H
1142 2716 28 41 C JR Z,CKFRT ;SECOND DIGIT = 4 TO CHECK THE FIRST DIGIT
1143 2718 D2 26D9 C JP NC,NOTEN ;SECOND DIGIT > 4 TO NOT ENTER
1144 271B 23 C INC HL ;POINT TO THE THIRD DIGIT
1145 271C 1E 64 C BCDTH: LD E,64H ;BCD 100D = HEX 64H
1146 271E CD 2764 C CALL MULTPY ;CALL MULTIPLY
1147 2721 4F C LD C,A ;SAVE THIRD DIGIT VALUE TO C
1148 2722 2B C DEC HL ;TO SECOND DIGIT
1149 2723 1E 0A C LD E,0AH ;BCD 10D = HEX 0AH
1150 2725 CD 2764 C CALL MULTPY ;CALL MULTIPLY
1151 2728 57 C LD D,A ;SAVE SECOND DIGIT VALUE TO D
1152 2729 2B C DEC HL ;TO FIRST DIGIT
1153 272A 7E C LD A,(HL) ;FIND HEX VALUE OF KEY DATA
1154 272B 82 C ADD A,D
1155 272C 81 C ADD A,C
1156 272D FE 00 C CP 00H
1157 272F CA 26D9 C JP Z,NOTEN
1158 2732 47 C LD B,A ;FIND CHANNEL CODE
1159 2733 1F C RRA
1160 2734 1F C RRA
1161 2735 1F C RRA
1162 2736 1F C RRA
1163 2737 E6 0F C AND OFH
1164 2739 4F C LD C,A
1165 273A 3E 10 C LD A,10H
1166 273C 91 C SUB C
1167 273D 57 C LD D,A
1168 273E 78 C LD A,B
1169 273F E6 0F C AND OFH
1170 2741 BA C CP D
1171 2742 30 01 C JR NC,ADD
1172 2744 0D C DEC C
1173 2745 78 C ADD: LD A,B
1174 2746 81 C ADD A,C
1175 2747 32 1879 C ENDACH: LD (CHDIS),A ;ENTER CHANNEL CODE
1176 274A 21 1815 C LD HL,BEFEN ;ENTER DATA TO CHDISD

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1177 274D 11 187A C LD DE,CHDISD
1178 2750 ED A0 C LDI
1179 2752 ED A0 C LDI
1180 2754 ED A0 C LDI
1181 2756 C3 26D4 C JP NOFUNC
1182 2759 2B C CKFRT: DEC HL ;CHECK THE FIRST DIGIT
1183 275A 7E C LD A,(HL)
1184 275B FE 00 C CP 00H
1185 275D C2 26D9 C JP NZ,NOTEN ;FIRST DIGIT > 0 TO NOT ENTER
1186 2760 3E FE C LD A,0FEH ;CHANNEL CODE AT 240 = 0FEH
1187 2762 1B E3 C JR ENDACH ;TO ENTER CHANNEL CODE
1188 2764 46 C MULTPY: LD B,(HL) ;MULTIPLIER TO B
1189 2765 AF C XOR A ;CLEAR RESULT
1190 2766 93 C SUB E ;PREPARE DATA FOR COMPARE
1191 2767 04 C INC B
1192 2768 83 C NTADD: ADD A,E ;MULTIPLY BY ADD
1193 2769 10 FD C DJNZ NTADD
1194 276B C9 C RET
1195 C INCLUDE B:TIMEN
1196 C ;*****
1197 C ;* TIME FUNCTION ENTER *
1198 C ;*****
1199 C ;ENTER KEY DATA TO WRITE MSM 5832 OR SET INTERVAL PRINT
1200 C ;TIME DATA HOUR = 0-23, MINUTE = 0-59
1201 C ;DATE DATA DAY = 1-31, MONTH = 1-12, YEAR = 00-99
1202 C ;
1203 276C 3A 1813 C TIMEN: LD A,(OPFUNC) ;CHECK OPERATED FUNCTION
1204 276F CB 5F C BIT 3,A
1205 2771 20 25 C JR NZ,INTVPR ;IN INTERVAL PRINT FUNCTION TO INTVPR
1206 2773 CB 57 C BIT 2,A
1207 2775 20 36 C JR NZ,WRDATE ;IN DATE FUNCTION TO WRDATE
1208 2777 06 00 C LD B,00H ;SET ERROR CODE
1209 2779 CD 280D C CALL CKTMD ;CALL CHECK TIME DATA
1210 277C AF C XOR A ;CHECK ERROR DATA
1211 277D BB C CP B
1212 277E C2 26D9 C JP NZ,NOTEN ;HAVE ERROR TO NOT ENTER
1213 2781 CB DE C SET 3,(HL) ;SET TO 24 HOURS MODE
1214 2783 16 C2 C LD D,0C2H ;HOLD TIME CODE
1215 2785 1E D2 C LD E,0D2H ;WRITE TIME CODE
1216 2787 21 1815 C LD HL,BEFEN ;WRITE FROM DATA BEFORE ENTER
1217 278A CD 2828 C CALL HOLDCK ;HOLD CLOCK BEFORE WRITE
1218 278D 06 04 C LD B,04H ;WRITE 4 BYTE
1219 278F CD 2835 C CALL NTWR ;WRITE DATA
1220 2792 CD 2844 C CALL RECLK ;RESET CLOCK
1221 2795 C3 26D4 C JP NOFUNC ;SET OPFUNC TO NO FUNCTION PROGRAM
1222 2798 06 00 C INTVPR: LD B,00H ;SET ERROR CODE
1223 279A CD 280D C CALL CKTMD ;CALL CHECK TIME DATA
1224 279D AF C XOR A ;CHECK ERROR DATA
1225 279E BB C CP B
1226 279F C2 26D9 C JP NZ,NOTEN ;HAVE ERROR TO NOT ENTER
1227 27A2 11 1880 C LD DE,PRTM+3 ;SET DESTINATION ADDRESS
1228 27A5 01 0004 C LD BC,04H ;SET COUNTER
1229 27AB ED BB C LDDR ;TRANSFER DATA
1230 27AA C3 26D4 C JP NOFUNC ;SET OPFUNC TO NO FUNCTION PROGRAM
1231 27AD 21 181A C WRDATE: LD HL,BEFEN+5 ;CHECK KEY DATE DATA
1232 27B0 7E C LD A,(HL)

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1233	27B1	FE 03	C	CP	03H	
1234	27B3	28 45	C	JR	Z,CKLOWD	;DATE > 30 TO CHECK DATA LOW DIGIT
1235	27B5	D2 26D9	C	JP	NC,NOTEN	;DATE > 39 TO NOT ENTER
1236	27B8	FE 00	C	CP	00H	;DATE < 10 CHECK IT IS 00 OR NOT
1237	27BA	20 08	C	JR	NZ,CKMTH	
1238	27BC	2B	C	DEC	HL	
1239	27BD	7E	C	LD	A,(HL)	
1240	27BE	FE 00	C	CP	00H	
1241	27C0	CA 26D9	C	JP	Z,NOTEN	;DATE = 00 TO NOT ENTER
1242	27C3	23	C	INC	HL	
1243	27C4	2B	C CKMTH:	DEC	HL	;CHECK MONTH DATA
1244	27C5	2B	C	DEC	HL	
1245	27C6	7E	C	LD	A,(HL)	
1246	27C7	FE 01	C	CP	01H	
1247	27C9	28 39	C	JR	Z,CKLOWM	;MONTH > 10 TO CHECK MONTH LOW DIGIT
1248	27CB	D2 26D9	C	JP	NC,NOTEN	;MONTH > 20 TO NOT ENTER
1249	27CE	2B	C	DEC	HL	;MONTH < 10 CHECK IT IS 00 OR NOT
1250	27CF	7E	C	LD	A,(HL)	
1251	27D0	FE 00	C	CP	00H	
1252	27D2	CA 26D9	C	JP	Z,NOTEN	;MONTH = 00 TO NOT ENTER
1253	27D5	16 C7	C OKWR:	LD	D,0C7H	;WRITE DATE TO CLOCK, HOLD CODE
1254	27D7	1E D7	C	LD	E,0D7H	;WRITE CODE
1255	27D9	21 1819	C	LD	HL,BEFEN+4	;START AT LOW BYTE DATE
1256	27DC	CD 2828	C	CALL	HOLDCK	;HOLD CLOCK BEFOR WRITE
1257	27DF	06 02	C	LD	B,02H	;WRITE 2 BYTE
1258	27E1	CD 2835	C	CALL	NTWR	;WRITE DATA
1259	27E4	21 1817	C	LD	HL,BEFEN+2	;LOW BYTE MONTH
1260	27E7	06 02	C	LD	B,02H	
1261	27E9	CD 2835	C	CALL	NTWR	
1262	27EC	21 1815	C	LD	HL,BEFEN	;LOW BYTE YEAR
1263	27EF	06 02	C	LD	B,02H	
1264	27F1	CD 2835	C	CALL	NTWR	
1265	27F4	CD 2844	C	CALL	RECLK	;RESET CLOCK
1266	27F7	C3 26D4	C	JP	NOFUNC	;SET TO NO FUNCTION PROGRAM
1267	27FA	2B	C CKLOWD:	DEC	HL	;CHECK DATE LOW DIGIT
1268	27FB	7E	C	LD	A,(HL)	
1269	27FC	FE 02	C	CP	02H	
1270	27FE	D2 26D9	C	JP	NC,NOTEN	;DATE > 31 TO NOT ENTER
1271	2801	23	C	INC	HL	
1272	2802	18 C0	C	JR	CKMTH	;TO CHECK MONTH
1273	2804	2B	C CKLOWM:	DEC	HL	;CHECK MONTH LOW DIGIT
1274	2805	7E	C	LD	A,(HL)	
1275	2806	FE 03	C	CP	03H	
1276	2808	D2 26D9	C	JP	NC,NOTEN	;MONTH > 12 TO NOT ENTER
1277	280B	18 C8	C	JR	OKWR	;TO WRITE DATE TO CLOCK
1278	280D	21 1816	C CKTMD:	LD	HL,BEFEN+1	;CHECK KEY DATA OF TIME
1279	2810	7E	C	LD	A,(HL)	
1280	2811	FE 06	C	CP	06H	
1281	2813	30 08	C	JR	NC,ERRDA	;MINUT > 59 TO NOT ENTER
1282	2815	23	C	INC	HL	;CHECK HOUR
1283	2816	23	C	INC	HL	
1284	2817	7E	C	LD	A,(HL)	
1285	2818	FE 02	C	CP	02H	
1286	281A	28 04	C	JR	Z,CKLOWH	;HOURS > 20 TO CHECK MONTH LOW DIGIT
1287	281C	D8	C	RET	C	;HOURS < 20 TIME DATA OK, > 30 TO NOT ENTER
1288	281D	06 01	C ERRDA:	LD	B,01H	;SET ERROR CODE

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1289 281F C9 C RET
1290 2820 2B C CKLOWH: DEC HL ;CHECK HOURS LOW DIGIT
1291 2821 7E C LD A,(HL)
1292 2822 FE 04 C CP 04H
1293 2824 30 F7 C JR NC,ERRDA ;HOURS > 23 TO NOT ENTER
1294 2826 23 C INC HL
1295 2827 C9 C RET
1296 2828 0E D1 C HOLDCK: LD C,PORTB1 ;ADDRESS AND CONTROL CLOCK IS PORT B
1297 282A 06 15 C LD B,CKHDLY ;SET DELAY TIME
1298 282C 3E 88 C LD A,88H ;SET 8255 PA,PB,PCL = OUTPUT, PCH = INPUT
1299 282E D3 D3 C OUT (CTRL1),A
1300 2830 ED 51 C OUT (C),D ;HOLD CLOCK
1301 2832 10 FE C DELAY1: DJNZ DELAY1 ;DELAY HOLD TIME
1302 2834 C9 C RET
1303 2835 7E C NTWR: LD A,(HL) ;SEND DATA
1304 2836 D3 D2 C OUT (PORTC1),A
1305 2838 ED 51 C OUT (C),D ;SEND ADDRESS
1306 283A ED 59 C OUT (C),E ;SEND WRITE PULSE
1307 283C ED 51 C OUT (C),D ;OFF WRITE PULSE
1308 283E 23 C INC HL ;NEXT DATA
1309 283F 14 C INC D ;NEXT ADDRESS
1310 2840 1C C INC E
1311 2841 10 F2 C DJNZ NTWR ;NEXT WRITE CYCLE
1312 2843 C9 C RET
1313 2844 3E 89 C RECLK: LD A,89H ;SET 8255 PA,PB = OUTPUT, PC = INPUT
1314 2846 D3 D3 C OUT (CTRL1),A
1315 2848 3E 80 C LD A,80H ;OFF HOLD CLOCK
1316 284A ED 79 C OUT (C),A
1317 284C C9 C RET
1318 C INCLUDE B:SETRUN
1319 C ;*****
1320 C ;* SET INITIAL DATA IN RUN MODE *
1321 C ;*****
1322 C ;LOAD PRM TO PTMDEC AND SET CHANNEL DISPLAY TIME
1323 C ;PRM IS 4 BYTE OF TIME VALUE
1324 C ;PTMDEC IS 2 BYTE OF HEXADECIMAL
1325 C ;
1326 284D 3A 181D C SETRUN: LD A,(TIMED) ;SAVE TOME FOR COMPARE
1327 2850 32 182E C LD (LASTM),A
1328 2853 3A 181F C LD A,(TIMED+2)
1329 2856 32 182F C LD (LINTV),A
1330 2859 3E 05 C LD A,CHGCH ;CHANGE CHANNEL TIME = CHGCH
1331 285B 32 1829 C LD (CDISTM),A
1332 285E 21 187D C LD HL,PRM ;CHANGE PRM TO HEXADECIMAL
1333 2861 CD 287F C CALL TBDHX ;CALL TWO BYTE BCD TO HEX VALUE
1334 2864 5F C LD E,A ;SAVE VALUE IN E
1335 2865 16 00 C LD D,00H ;SET DE FOR HEX VALUE
1336 2867 23 C INC HL ;TO HOURS DATA
1337 2868 CD 287F C CALL TBDHX ;CALL TWO BYTE BCD TO HEX VALUE
1338 286B 47 C LD B,A ;SAVE VALUE IN B
1339 286C EB C EX DE,HL ;USE HL TO CALCULATE 16 BITS
1340 286D 11 003C C LD DE,003CH ;BCD 60D = HEX 3CH
1341 2870 CD 288A C CALL TBMULT ;CALL MULTIPLY
1342 2873 EB C EX DE,HL ;USE HL FOR ADDRESSING
1343 2874 21 182A C LD HL,PTMDEC ;INTERVAL PRINT TIME FOR CHECK AT PTMDEC
1344 2877 73 C LD (HL),E ;SAVE HEX VALUE IN PTMDEC

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1345 2878 23 C INC HL
1346 2879 72 C LD (HL),D
1347 287A 23 C INC HL
1348 287B 73 C LD (HL),E ;SAVE HEX VALUE IN PTMDEC+2 FOR RESET
1349 287C 23 C INC HL
1350 287D 72 C LD (HL),D
1351 287E C9 C RET
1352 287F 7E C TBDHX: LD A,(HL) ;LOW DIGIT SAVE IN A
1353 2880 23 C INC HL
1354 2881 46 C LD B,(HL) ;HIGH DIGIT SAVE IN B
1355 2882 0E 0A C LD C,0AH ;BCD 10D = HEX 0AH
1356 2884 91 C SUB C ;PREPARE DATA FOR MULTIPLY
1357 2885 04 C INC B
1358 2886 81 C NTADD1: ADD A,C ;MULTIPLY BY ADD
1359 2887 10 FD C DJNZ NTADD1 ;CHECK MULTIPLIER
1360 2889 C9 C RET
1361 288A 37 C TBMULT: SCF ;SET CARRY FLAG TO 0
1362 288B 3F C CCF
1363 288C ED 52 C SBC HL,DE ;PREPARE DATA FOR MULTIPLY
1364 288E 04 C INC B
1365 288F 19 C NTADD2: ADD HL,DE ;MULTIPLY BY ADD
1366 2890 10 FD C DJNZ NTADD2 ;CHECK MULTIPLIER
1367 2892 C9 C RET
1368 C INCLUDE B:OPFUNC
1369 C ;*****
1370 C ;* OPERATED FUNCTION *
1371 C ;*****
1372 C ;THIS PROGRAM JUMP FROM FUNCTION KEY
1373 C ;ADDRESS OF LABEL ARE IN FUNMAP
1374 C ;SET OPERATED FUNCTION TO MATCH WITH PRESSED KEY
1375 C ;
1376 2893 3E B4 C DAHLD: LD A,0B4H ;DATE HOLD OPERATED FUNCTION IS
1377 2895 32 1813 C LD (OPFUNC),A ; 1011 0100
1378 2898 C9 C RET
1379 2899 3E B0 C TMHLD: LD A,0B0H ;TIME HOLD OPERATED FUNCTION IS
1380 289B 32 1813 C LD (OPFUNC),A ; 1011 0000
1381 289E C9 C RET
1382 289F 3E B8 C INHLD: LD A,0B8H ;INTERVAL PRINT HOLD OPERATED FUNCTION IS
1383 28A1 32 1813 C LD (OPFUNC),A ; 1011 1000
1384 28A4 C9 C RET
1385 28A5 3E B4 C HLHLD: LD A,0B4H ;HIGH LIMIT HOLD OPERATED FUNCTION IS
1386 28A7 32 1813 C LD (OPFUNC),A ; 1000 0100
1387 28AA C9 C RET
1388 28AB 3E B8 C LLHLD: LD A,0B8H ;LOW LIMIT HOLD OPERATED FUNCTION IS
1389 28AD 32 1813 C LD (OPFUNC),A ; 1000 1000
1390 28B0 C9 C RET
1391 28B1 3E 90 C RGHLD: LD A,090H ;RANGE HOLD OPERATED FUNCTION IS
1392 28B3 32 1813 C LD (OPFUNC),A ; 1001 0000
1393 28B6 C9 C RET
1394 28B7 3E A0 C CHHLD: LD A,0A0H ;CHANNEL HOLD OPERATED FUNCTION IS
1395 28B9 32 1813 C LD (OPFUNC),A ; 1010 0000
1396 28BC C9 C RET
1397 28BD 3E 01 C PTHLD: LD A,01H ;SET PRINT HOLD STATE TO PRINT
1398 28BF 32 181C C LD (PRNT),A
1399 28C2 C9 C RET
1400 28C3 3E F4 C DAPRO: LD A,0F4H ;DATE PROGRAM OPERATED FUNCTION IS

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1401 28C5 32 1813 C LD (DPFUNC),A ; 1111 0100
1402 28C8 C9 C RET
1403 28C9 3E F0 C TMPRO: LD A,0F0H ;TIME PROGRAM OPERATED FUNCTION IS
1404 28CB 32 1813 C LD (DPFUNC),A ; 1111 0000
1405 28CE C9 C RET
1406 28CF 3E F8 C INPRO: LD A,0FBH ;INTERVAL PRINT PROGRAM OPERATED FUNCTION IS
1407 28D1 32 1813 C LD (DPFUNC),A ; 1111 1000
1408 28D4 C9 C RET
1409 28D5 3E C4 C HLPRO: LD A,0C4H ;HIGH LIMIT PROGRAM OPERATED FUNCTION IS
1410 28D7 32 1813 C LD (DPFUNC),A ; 1100 0100
1411 28DA C9 C RET
1412 28DB 3E C8 C LLPRO: LD A,0CBH ;LOW LIMIT PROGRAM OPERATED FUNCTION IS
1413 28DD 32 1813 C LD (DPFUNC),A ; 1100 1000
1414 28E0 C9 C RET
1415 28E1 3E D0 C RGPRO: LD A,0D0H ;RANGE PROGRAM OPERATED FUNCTION IS
1416 28E3 32 1813 C LD (DPFUNC),A ; 1101 0000
1417 28E6 C9 C RET
1418 28E7 3E E0 C CHPRO: LD A,0E0H ;CHANNEL PROGRAM OPERATED FUNCTION IS
1419 28E9 32 1813 C LD (DPFUNC),A ; 1110 0000
1420 28EC C9 C RET
1421 28ED 3E FF C PTPRO: LD A,0FFH ;SET PRINT PROGRAM STATE TO PRNT
1422 28EF 32 181C C LD (PRNT),A
1423 28F2 C9 C RET
1424 C INCLUDE B:NUMB
1425 C ;*****
1426 C ;* NUMBER KEY *
1427 C ;*****
1428 C ;SHIFT NUMBER BEFORE ENTER 6 BYTE
1429 C ;THE LAST BYTE IS FILLED WITH PRESSED KEY
1430 C ;
1431 28F3 11 181A C NUMB: LD DE,BEFEN+5 ;SET DESTINATION ADDRESS
1432 28F6 21 1819 C LD HL,BEFEN+4 ;SET SOURCE ADDRESS
1433 28F9 01 0005 C LD BC,0005H ;SET COUNTER
1434 28FC ED BB C LDDR ;TRANSFER DATA
1435 28FE 3A 1812 C LD A,(LASTK) ;LOAD PRESSED KEY TO THE LAST BYTE
1436 2901 12 C LD (DE),A
1437 2902 C9 C RET
1438 C INCLUDE B:MINUS
1439 C ;*****
1440 C ;* MINUS KEY *
1441 C ;*****
1442 C ;THIS FUNCTION IS TROGGLE STATE
1443 C ;THIS KEY USE IN DATA ONLY
1444 C ;
1445 2903 3A 1813 C MINUS: LD A,(DPFUNC) ;CHECK OPERATED FUNCTION
1446 2906 E6 30 C AND 30H
1447 2908 C0 C RET NZ ;NOT DATA FUNCTION TO RETURN
1448 2909 21 181B C LD HL,BEFEN+6 ;CHECK PRESENT STATE
1449 290C AF C XOR A
1450 290D BE C CP (HL)
1451 290E 28 02 C JR Z,SETMI ;PRESENT STATE IS PLUS SET TO MINUS
1452 2910 77 C LD (HL),A ;SET TO PLUS STATE
1453 2911 C9 C RET
1454 2912 36 02 C SETMI: LD (HL),02H ;SET TO MINUS STATE
1455 2914 C9 C RET
1456 C INCLUDE B:CLEAR

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1457      C ;*****
1458      C ;*          CLEAR KEY          *
1459      C ;*****
1460      C ;SET NUMBER BEFORE ENTER TO ZERO
1461      C ;
1462      2915  21 1815  C CLEAR:  LD      HL,BEFEN      ;SET DESTINATION ADDRESS
1463      2918  AF      C          XOR      A          ;SOURCE IS ZERO
1464      2919  06 07   C          LD      B,07H      ;SET CUNTER
1465      291B  77     C CLOOP:  LD      (HL),A      ;CLEAR LOOP
1466      291C  23     C          INC      HL
1467      291D  10 FC  C          DJNZ   CLOOP
1468      291F  C9     C          RET
1469      C          INCLUDE B:DEFW
1470      C ;*****
1471      C ;*          DEFINE WORD        *
1472      C ;*****
1473      C ;
1474      2920  25CF   C KGRP:  DEFW   DATA      ;KEY GROUP SUBROUTINE
1475      2922  25B0   C          DEFW   FUNCCK
1476      2924  257F   C          DEFW   MODEK
1477      2926  2561   C          DEFW   ENTER
1478      2928  255D   C          DEFW   REALM
1479      292A  28B7   C FUNMAP: DEFW   CHHLD      ;SET OPERATED FUNCTION SUBROUTINE
1480      292C  28B1   C          DEFW   RGHLD
1481      292E  2899   C          DEFW   TMHLD
1482      2930  2893   C          DEFW   DAHLD
1483      2932  289F   C          DEFW   INHLD
1484      2934  28BD   C          DEFW   PTHLD
1485      2936  28A5   C          DEFW   HLHLD
1486      2938  28AB   C          DEFW   LLHLD
1487      293A  28E7   C          DEFW   CHPRO
1488      293C  28E1   C          DEFW   R6PRO
1489      293E  28C9   C          DEFW   TMPRO
1490      2940  28C3   C          DEFW   DAPRO
1491      2942  28CF   C          DEFW   INPRO
1492      2944  28ED   C          DEFW   PTPRO
1493      2946  28D5   C          DEFW   HLPRO
1494      2948  28DB   C          DEFW   LLPRO
1495      294A  2608   C ENKFN: DEFW   LIMEN      ;ENTER KEY SUBROUTINE
1496      294C  269E   C          DEFW   RGEN
1497      294E  2707   C          DEFW   CHNEN
1498      2950  276C   C          DEFW   TIMEN
1499      2952  20A4   C FUDIS: DEFW   CHDATA      ;FUNCTION DISPLAY SUBROUTINE
1500      2954  21CF   C          DEFW   HLTHLD
1501      2956  21DE   C          DEFW   LLTHLD
1502      2958  21ED   C          DEFW   RAGHLD
1503      295A  2233   C          DEFW   CHNSET
1504      295C  2257   C          DEFW   TIMHLD
1505      295E  229E   C          DEFW   DATHLD
1506      2960  22C9   C          DEFW   INVHLD
1507      2962  22D9   C          DEFW   PROGM
1508      2964  22F5   C          DEFW   HLTPRO
1509      2966  22FE   C          DEFW   LLTPRO
1510      2968  236D   C          DEFW   RAGPRO
1511      296A  2233   C          DEFW   CHNSET
1512      296C  239A   C          DEFW   TIMPRO

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1513 296E 23B7 C DEFW DATPRO
1514 2970 23A3 C DEFW INVPRO
1515 C INCLUDE B:DEFB
1516 C ;*****
1517 C ;* DEFINE BYTE *
1518 C ;*****
1519 C ;
1520 2972 00 C KMAP: DEFB 000H ;NO KEY
1521 2973 20 C DEFB 020H ;HOLD
1522 2974 21 C DEFB 021H ;PRO
1523 2975 16 C DEFB 016H ;HLINT
1524 2976 17 C DEFB 017H ;LLINT
1525 2977 12 C DEFB 012H ;TIME
1526 2978 10 C DEFB 010H ;CHAN
1527 2979 14 C DEFB 014H ;INTV
1528 297A 40 C DEFB 040H ;RESET
1529 297B 13 C DEFB 013H ;DATE
1530 297C 11 C DEFB 011H ;RANGE
1531 297D 15 C DEFB 015H ;PRINT
1532 297E 30 C DEFB 030H ;ENTER
1533 297F 09 C DEFB 009H ;9
1534 2980 06 C DEFB 006H ;6
1535 2981 03 C DEFB 003H ;3
1536 2982 08 C DEFB 008H ;CR
1537 2983 08 C DEFB 008H ;8
1538 2984 05 C DEFB 005H ;5
1539 2985 02 C DEFB 002H ;2
1540 2986 00 C DEFB 000H ;0
1541 2987 07 C DEFB 007H ;7
1542 2988 04 C DEFB 004H ;4
1543 2989 01 C DEFB 001H ;1
1544 298A 0A C DEFB 00AH ;+/-
1545 298B BD C SEGCD: DEFB 0BDH ;0
1546 298C 30 C DEFB 030H ;1
1547 298D 9B C DEFB 09BH ;2
1548 298E BA C DEFB 0BAH ;3
1549 298F 36 C DEFB 036H ;4
1550 2990 AE C DEFB 0AEH ;5
1551 2991 AF C DEFB 0AFH ;6
1552 2992 38 C DEFB 038H ;7
1553 2993 BF C DEFB 0BFH ;8
1554 2994 BE C DEFB 0BEH ;9
1555 2995 0F C DEFB 00FH ;F
1556 2996 02 C PRDG: DEFB 002H ;-
1557 2997 00 C DEFB 000H ;BLANK
1558 2998 1F C DEFB 01FH ;P
1559 2999 03 C DEFB 003H ;R
1560 299A A3 C DEFB 0A3H ;0
1561 299B AD C DEFB 0ADH ;G
1562 299C 00 C DEFB 000H ;BLANK
1563 299D 02 C DEFB 002H ;-
1564 299E 00 C RAGFMT:: DEFB 000H ;NOT USE
1565 299F 03 C DEFB 003H ;mV 1.XXX
1566 29A0 02 C DEFB 002H ;mV 1X.XX
1567 29A1 01 C DEFB 001H ;mV 1XX.X
1568 29A2 00 C DEFB 000H ;mV 1XXX

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1569 29A3 12 C DEFB 012H ; V 1X.XX
1570 29A4 22 C DEFB 022H ; mA 1X.XX
1571 29A5 21 C DEFB 021H ; mA 1XX.X
1572 29A6 30 C DEFB 030H ; C 1XXX
1573 29A7 31 C DEFB 031H ; C 1XX.X
1574 29A8 40 C DEFB 040H ; F 1XXX
1575 29A9 41 C DEFB 041H ; F 1XX.X
1576 29AA 31 C DEFB 031H ; C 1XX.X
1577 29AB 41 C DEFB 041H ; F 1XX.X
1578 29AC 31 C DEFB 031H ; C 1XX.X
1579 29AD 41 C DEFB 041H ; F 1XX.X
1580 29AE 8F C HEADIS:: DEFB 08FH ;E
1581 29AF 8F C DEFB 08FH ;E
1582 29B0 02 C DEFB 002H ;-
1583 29B1 8D C DEFB 08DH ;C
1584 29B2 37 C DEFB 037H ;H
1585 29B3 85 C DEFB 085H ;U
1586 29B4 85 C DEFB 085H ;L
1587 29B5 3F C DEFB 03FH ;A
1588 29B6 FF C DEFB 0FFH ;LAMP
1589 29B7 00 C HUNDAT:: DEFB 000H
1590 29B8 00 C DEFB 000H
1591 29B9 56 C DEFB 056H
1592 29BA 02 C DEFB 002H
1593 29BB 12 C DEFB 012H
1594 29BC 05 C DEFB 005H
1595 29BD 68 C DEFB 068H
1596 29BE 07 C DEFB 007H
1597 29BF 24 C DEFB 024H
1598 29C0 10 C DEFB 010H
1599 29C1 80 C DEFB 080H
1600 29C2 12 C DEFB 012H
1601 29C3 36 C DEFB 036H
1602 29C4 15 C DEFB 015H
1603 29C5 92 C DEFB 092H
1604 29C6 17 C DEFB 017H
1605 29C7 48 C DEFB 048H
1606 29C8 20 C DEFB 020H
1607 C INCLUDE B:EQUATE
1608 C ;*****
1609 C ;* EQUATE *
1610 C ;*****
1611 C ;
1612 C PUBLIC CTC0,CTC1,CTC2,CTC3,PIODA,PIODB,PIOCA,PIOCB
1613 0040 C CTC0 EQU 040H ;CTC CHANNEL 0-3
1614 0041 C CTC1 EQU 041H
1615 0042 C CTC2 EQU 042H
1616 0043 C CTC3 EQU 043H
1617 0080 C PIODA EQU 080H ;PIO PORT A DATA SELECT
1618 0081 C PIODB EQU 081H ; PORT B DATA SELECT
1619 0082 C PIOCA EQU 082H ; PORT A CONTROL SELECT
1620 0083 C PIOC B EQU 083H ; PORT B CONTROL SELECT
1621 C PUBLIC PORTA1,PORTB1,PORTC1,CTRL1,PORTA2,PORTB2,PORTC2,CTRL2,CTRL3
1622 00D0 C PORTA1 EQU 0D0H ;B255 FOR PRINTER AND CLOCK
1623 00D1 C PORTB1 EQU 0D1H
1624 00D2 C PORTC1 EQU 0D2H

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1625 00D3      C CTRL1 EQU 0D3H
1626 00C8      C PORTA2 EQU 0C8H ;8255 FOR SCAN CHANNEL AND ALARM
1627 00C9      C PORTB2 EQU 0C9H
1628 00CA      C PORTC2 EQU 0CAH
1629 00CB      C CTRL2 EQU 0CBH
1630 00D8      C PORTA3 EQU 0D8H ;8255 FOR SCAN KEYBOARD AND DISPLAY
1631 00D9      C PORTB3 EQU 0D9H
1632 00DA      C PORTC3 EQU 0DAH
1633 00DB      C CTRL3 EQU 0DBH
1634          C PUBLIC DB251,CB251,START,SNDLY,POWDLY
1635 00FB      C DB251 EQU 0FBH ;8251 DATA
1636 00F9      C CB251 EQU 0F9H ;8251 CONTROL
1637 00C0      C START EQU 0C0H ;TRIGGER 555 TO START CONVERSION
1638 0005      C CHGCH EQU 005H ;CHANGE CHANNEL TIME IN RUN MODE
1639 00C9      C SNDLY EQU 0C9H ;DELAY TIME IN SERIAL COMM.
1640 0015      C CKHDLY EQU 015H ;CLOCK HOLD FOR WRITE
1641 0000      C POWDLY EQU 000H ;DELAY POWER UP
1642          .DEPHASE
1643          C INCLUDE B:DEFS
1644          C ;*****
1645          C ;* DEFINE SPACE *
1646          C ;*****
1647          C ;
1648          C .PHASE 1800H
1649 1800      C FIRST:: DEFS 1 ;FRIST ADDRESS TO INITIAL
1650 1801      C DIGIT:: DEFS 1 ;DIGIT DISPLAY
1651 1802      C DISB:: DEFS 9 ;DISPLAY BUFFER
1652 180B      C KCOUNT:: DEFS 1 ;SCAN KEY COUNTER
1653 180C      C KDBOUC:: DEFS 1 ;KEY DEBOUNCE
1654 180D      C KPRESS:: DEFS 1 ;PRESSED KEY
1655 180E      C RDTM:: DEFS 1 ;INTERRUPT COUNT
1656 180F      C CHTM:: DEFS 1 ;CHANGE CHANNEL TIME COMMAND STATUS
1657 1810      C INTVTM:: DEFS 1 ;INTERVAL PRINT TIME COMMAND STATUS
1658 1811      C OLDK:: DEFS 1 ;OLD KEY STATUS
1659 1812      C LASTK:: DEFS 1 ;LAST KEY CODE
1660 1813      C OPFUNC:: DEFS 1 ;OPERATED FUNCTION CODE
1661 1814      C PMDTM:: DEFS 1 ;PRINT MODE AND TIME COMMAND STATUS
1662 1815      C BEFEN:: DEFS 7 ;NUMBER KEY BUFFER BEFORE ENTER
1663 181C      C PRNT:: DEFS 1 ;PRINT COMMAND STATUS
1664 181D      C TIMED:: DEFS 12 ;TIME DATA AREA
1665 1829      C CDISTM:: DEFS 1 ;CHANNEL DISPLAY TIME
1666 182A      C PTMDEC:: DEFS 4 ;INTERVAL PRINT TIME HEX VALUE*FOR DECREMENT
1667 182E      C LASTM:: DEFS 1 ;LAST DISPLAY TIME IN SEC
1668 182F      C LINTV:: DEFS 1 ;LAST INTERVAL PRINT TIME IN MINUTE
1669 1830      C SERIN:: DEFS 1 ;SERIAL COMM. INTERRUPT STATUS
1670 1831      C ADINT1:: DEFS 1 ;A/D INTERRUPT STATUS
1671 1832      C NOTPRG:: DEFS 1 ;NOT PROGRAM STATUS
1672 1833      C CTRLP:: DEFS 3 ;CONTROL PRINTER BUFFER
1673 1836      C SNDBUF:: DEFS 20 ;SEND DATA BUFFER
1674 184A      C CHNSND:: DEFS 1 ;CURRENT CHANNEL SEND
1675 184B      C SNTDYP:: DEFS 1 ;TYPE OF SEND DATA PRINTER OR SERIAL COMM.
1676 184C      C CTRLS:: DEFS 1 ;SEND CONTROL COMMAND STATUS
1677 184D      C XORST:: DEFS 1 ;FRIST SEND TO XOR STATUS
1678 184E      C XORBUF:: DEFS 1 ;XOR BUFFER
1679 184F      C FOUND:: DEFS 1 ;FOUND ABNDRMAL DATA STATUS
1680 1850      C DCMSND:: DEFS 1 ;CURRENT SEND DECIMAL CODE

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1681	1851	C UNTSND:: DEFS	1	;CURRENT UNIT SEND CODE
1682	1852	C RAGSND:: DEFS	1	;CURRENT RANGE SEND
1683	1853	C ADDAT:: DEFS	2	;DATA DUFFER READ FROM A/D
1684	1855	C CUSCHN:: DEFS	1	;CURRENT SCAN CHANNEL
1685	1856	C LSTCU:: DEFS	1	;LAST CURRENT SCAN CHANNEL
1686	1857	C ALMST:: DEFS	1	;ALARM STATUS
1687	1858	C REFST:: DEFS	1	;REFRESH DISPLAY STATUS
1688	1859	C REFCHN:: DEFS	1	;REFRESH CHANNEL
1689	185A	C CKNPG:: DEFS	1	;CHECK PROGRAM CHANNEL STATUS
1690	185B	C DATBUF:: DEFS	4	;DATA BUFFER BEFORE TO DISB
1691	185F	C DEFS	23	;SPACE AVAILABLE
1692	1876	C CURBUF:: DEFS	2	;CURRENT DISPLAY BUFFER
1693	1878	C BATT1:: DEFS	1	;BATTERY CHECK
1694	1879	C CHDIS:: DEFS	1	;CURRENT CHANNEL DISPLAY
1695	187A	C CHDISD:: DEFS	3	;CURRENT CHANNEL DISPLAY IN BCD
1696	187D	C PRM:: DEFS	4	;INTERVAL PRINT TIME PROGRAM
1697	1881	C RANGE:: DEFS	16	;RANGE PROGRAM AREA
1698	1891	C DATA:: DEFS	512	;DATA BUFFER
1699	1A91	C HLINT:: DEFS	512	;HIGH LIMIT PROGRAM AREA
1700	1C91	C LLINT:: DEFS	512	;LOW LIMIT PROGRAM AREA
1701	1E91	C BATT2:: DEFS	1	
1702	1E92	C SPACE1:: DEFS	253	;STACK SPACE
1703	1F8F	C STKPT:: DEFS	1	;STACK POINTER
1704	1F90	C SPACE2:: DEFS	2	;STACK SPACE
1705		C .DEPHASE		
1706		END		

Macros:

Symbols:

2745	ADD	1853I	ADDA	23D1I	ADINT
1831I	ADINT1	1857I	ALMST	2283	B2TRN
1878I	BATT1	1E91I	BATT2	271C	BCDTH
1815I	BEFEN	2267	BLK3D	00F9I	C825I
2655	CACLR	261B	CACRAD	25F0	CCLR
1829I	CDISTM	20BF	CHANNL	20A4	CHDATA
1879I	CHDIS	187AI	CHDISD	0005	CHGCH
2057	CHGCHN	2887	CHHLD	2100	CHKBKD
2707	CHNEN	2233	CHNSET	184AI	CHNSND
2663	CHNUSE	28E7	CHPRO	20C3	CHSIY
180FI	CHTM	2759	CKFRT	0015	CKHDLY
27FA	CKLOWD	2820	CKLOWH	2804	CKLOWM
27C4	CKMTH	185AI	CKNPG	280D	CKTMD
206FI	CKUSE	2915	CLEAR	291B	CLOOP
25EC	CNUMB	0040I	CTC0	0041I	CTC1
0042I	CTC2	0043I	CTC3	2031	CTDI
00D3I	CTRL1	00CB1	CTRL2	00DB1	CTRL3
1833I	CTRLP	184CI	CTRLS	2692I	CURADD
1876I	CURBUF	26E4	CURHLT	26F8I	CURRAG
1855I	CUSCHN	00F8I	D825I	2893	DAHLD
28C3	DAPRO	1891I	DATA	25DF	DATAF
25CF	DATAK	185BI	DATBUF	229E1	DATHLD
23B7	DATPRO	2152	DATRAN	2172	DBKC
212F	DBKD	1850I	DCMSND	2185	DECIPT
2329	DECPT	2182	DEFOR	24C2	DEKDB
2832	DELAY1	21A2	DETRD	1801I	DIGIT
1802I	DISB	2455	DISPLAY	23AC	DISTM
21C4	DTSEG	2747	ENDACH	294A	ENKFN
26BB	ENRDA	2561	ENTER	2419	EPRO
281D	ERRDA	201C	FINDF	1800I	FIRST
184FI	FOUND	2952	FUDIS	25C3	FUNCJP
25B0	FUNCK	2000I	FUNDIS	292A	FUNMAP
29AEI	HEADIS	259B	HLCD	2251	HLDM
28A5	HLHLD	1A91I	HLINT	28D5	HLPRO
21CF	HLTHLD	22F5	HLTPRO	2828	HOLDCK
25A1	HOLDK	233C	HONE	2016	HPROFC
29B7I	HUNDAT	2084I	HXTBCD	289F	INHLD
28CF	INPRO	2798	INTVPR	1810I	INTVTM
22C9	INVHLD	23A3	INVPRO	180B1	KCOUNT
180CI	KDBOUC	253B	KEYGP	249E	KEYOP
2920	KGRP	2972	KMAP	180DI	KPRESS
2489	KROW	1812I	LASTK	182E1	LASTM
2608	LIMEN	182FI	LINTV	28AB	LLHLD
1C91I	LLIMT	28DB	LLPRO	21DE	LLTHLD
22FE	LLTPRO	265E	LOWLIM	1856I	LSTCU
2307	LTPRO	2046	MAPJP	2903	MINUS
257F	MODEK	2764	MULTPY	2466	NEXTD
26D4	NOFUNC	2497	NOKEY	26DD	NORMDA
216C	NOTBKC	212B	NOTBKD	26D9	NOTEN
2641	NOTONE	1832I	NOTPRG	20EC	NOTSD
2768	NTADD	2886	NTADD1	28BF	NTADD2
26CE	NTRES	26C3	NTSET	2094	NTSUB

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209E	NTSUB1	223D	NITRAN	22E3	NTRN
2835	NTWR	20D1	NUDATA	28F3	NUMB
226E	NXTRN	27D5	OKWR	18111	OLDK
210E	ONEBKD	18131	OPFUNC	240E	OUTINT
20771	PASS	00821	PIOCA	00831	PIOCB
00801	PIODA	00811	PIODB	2053	PMODE
18141	PMOTM	00D01	PORTA1	00C81	PORTA2
00D8	PORTA3	00D11	PORTB1	00C91	PORTB2
00D9	PORTB3	00D21	PORTC1	00CA1	PORTC2
00DA	PORTC3	00001	PODWLY	259E	PRCD
181C1	PRNT	257B	PROF	25F4	PROFNC
2996	PROG	22D9	PROGM	187D1	PRTM
288D	PTHLD	182A1	PTMDEC	28ED	PTPRO
299E1	RAGFMT	21ED	RAGHLD	236D	RAGPRO
18521	RAGSND	18811	RANGE	2484	RDKEY
180E1	RDTM	255D	REALM	2844	RECLK
18591	REFCHN	18581	REFST	24C9	REKPR
248C	REDLK	268E	REST	269E	RGEN
28B1	RGHLD	222B	RGLDIS	28E1	RGPRO
26CB	RSBIT	20BA	RUNMD	24CE	RUNTM
2477	SCAN	2441	SCANDIS	242B1	SCNINT
24FF	SCOMD	298B	SEGCD	2384	SEMDB
2575	SENH	18301	SERIN	23F31	SERINT
2912	SETM1	284D	SETRUN	252B	SINCOM
18361	SNDBUF	00C91	SNDLY	2424	SNDNAC
184B1	SNDTYP	1E921	SPACE1	1F901	SPACE2
00C01	START	1F8F1	STKPT	287F	TBDHX
2217	TBDIS	288A	TBMULT	2112	TBTKD
181D1	TIMED	276C	TIMEN	22571	TIMHLD
239A	TIMPRO	2899	TMHLD	28C9	TMPRO
2276	TMTRN	3427*	TX	18511	UNTSND
27AD	WRDATE	184E1	XORBUF	184D1	XORST

No Fatal error(s)

C

FUNDIS	11#								
FUNMAP	911	1479#							
HEADIS	1580#								
HLCD	884#	891							
HLDMD	351	355#							
HLHLD	1385#	1485							
HLINT	81	283	980	1036	1104	1699#			
HLPRO	1409#	1493							
HLTHLD	282#	1500							
HLTPRO	453#	1508							
HOLDCK	1217	1256	1296#						
HOLDK	877	888#							
HONE	468	485#							
HPROFC	13	20#							
HUNDAT	1589#								
HXTBCD	66	87#							
INHLD	1382#	1483							
INPRO	1406#	1491							
INTVPR	1205	1222#							
INTVTM	804	1657#							
INVHLD	423#	1506							
INVPRO	539#	1514							
KCOUNT	699	713	1652#						
KDBOUC	708	723	739	741	1653#				
KEYGP	734	813#							
KEYOP	662	723#							
KGRP	824	1474#							
KMAP	814	1520#							
KPRESS	710	726	743	813	1654#				
KROW	704#	711							
LASTK	819	875	905	936	1435	1659#			
LASTM	762	766	1327	1667#					
LIMEN	973#	1495							
LINTV	781	785	1329	1668#					
LLHLD	1388#	1486							
LLINT	295	1025	1027	1700#					
LLPRO	1412#	1494							
LLTHLD	294#	1501							
LLTPRO	457#	1509							
LOWLIM	977	1025#							
LSTCU	1685#								
LTPRO	453	457	461#						
MAPJP	26	29	32	34	40	44	47	50#	
MINUS	940	1445#							
MODEK	871#	1476							
MULTPY	1146	1150	1188#						
NEXTD	678	681#							
NOFUNC	1091	1097#	1181	1221	1230	1266			
NOKEY	706	711#							

PROG	436	1556#				
PROGM	435#	1507				
PRTH	424	1227	1332	1696#		
PTHLD	1397#	1484				
PTMDEC	792	797	799	800	1343	1666#
PTPRO	1421#	1492				
RAGFMT	233	1564#				
RAGHLD	305#	1502				
RAGPRO	510#	1510				
RAGSND	1682#					
RANGE	1115	1697#				
RDKEY	698	701#				
RDTM	755	757	761	1655#		
REALM	839#	1478				
RECLK	1220	1265	1313#			
REFCHN	1688#					
REFST	1687#					
REKPR	731	735	738	742#		
REDLK	725	736#				
REST	1049	1053#				
RGEN	1071#	1496				
RGHLD	1391#	1480				
RGLDIS	322	332#				
RGPRO	1415#	1488				
RSBIT	1085	1092#				
RUNMD	123	127#				
RUNTH	664	752#				
SCAN	661	695#				
SCANDIS	640	658#				
SCNINT	634#					
SCOND	774	777#				
SEBCD	271	1545#				
SENDB	517	519#				
SENH	857	859#				
SERIN	611	623	1669#			
SERINT	597#					
SETMI	1451	1454#				
SETRUN	893	1326#				
SINCOM	796	799#				
SNDBUF	1673#					
SNDLY	1634	1639#				
SNDNAC	621	625#				
SNDTYP	1675#					
SPACE1	1702#					
SPACE2	1704#					
START	1634	1637#				
STKPT	1703#					
TBDHX	1333	1337	1352#			
TBDIS	316	323#				

ประวัติผู้เขียน

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คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย เมื่อปี พ.ศ. 2522

