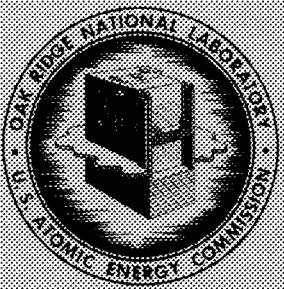
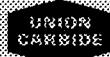


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## NEW DATA SYSTEM FOR INTERIM

J. E. Francis and C. C. Yonts

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## ABSTRACT

The new data system for INTEREM using a PDP-12 computer is described. Listings of the control program and subroutines along with interface wiring diagrams are included as appendices.

## INTRODUCTION

A PDP-12 computer is now being used for data acquisition on the experimental CTR machines INTEREM and IMP.<sup>1</sup> This system replaces the LINC-8 system previously used on INTEREM and described in ORNL 4425. The PDP-12 serves the dual purpose of data acquisition and data analysis.

## SYSTEM DESCRIPTION

The PDP-12 used in this system is a 12 bit machine with 16 K of core memory, two TU 55 magnetic tape transports, an RS/8 magnetic disc (256 K), 32 A-D converters, and a cathode ray display unit. Bremstrahlung spectra are collected by a HP 5401B multichannel analyzer.<sup>2</sup> The interfaces for this and other sensors are described in Appendix 4. The machine parameters recorded are: pressure, mirror coil current, quadrupole coil current, 3 cm microwave power input, and 8 mm microwave power input. Date and run number are also recorded.

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<sup>1</sup>Thermonuclear Div. Ann. Progr. Rept. Dec. 31, 1969, ORNL 4545, pp. 39 - 56.

<sup>2</sup>Trademark of Hewlett-Packard Company.

## SOFTWARE SYSTEM

The software consists of a control program and various subroutines which are called into core from magnetic tape as needed. Use of subroutines makes program changes much easier as the need arises.

When read into core and started, the control program first calls Dec Q & A,<sup>3</sup> a question and answer subroutine. This subroutine has been programmed to ask for the date and store it in the proper location in memory; it also issues a warning to have a data tape on Tape Transport 1. After the date has been entered via teletype, typing LF (line feed) causes the program to continue. The remainder of the program is then read into core writing over the Q & A subroutine in the process. The location of the control program and subroutines is shown in the core maps, Figs. 1 - 4. When the last of the program is read into core, the system is waiting for a dump of the multichannel analyzer. When the analyzer is dumped, the data along with all machine parameters is read into core, converted to single precision floating point format, and stored on magnetic tape. The run number in the control program is automatically updated along with the next tape storage locations. Since the serial output connection of the HP analyzer was utilized, the internal programming of the analyzer must be taken into account by the computer program. The beginning and end of message signals are utilized to obtain a data word count which is used to determine the number of points to be analyzed. Data output from the HP can be 256 words (one quarter of memory), 512 words (two quarters), or 1024 words (all four quarters). In addition, memory locations are outputted every ten data words. The initial memory location is stored and can be used to determine which quarter or quarters of memory were dumped. The remainder are discarded along with the zeros following the end of message signal.

Analysis of the spectra data is done by a FOCAL<sup>3</sup> program. FOCAL was chosen for its language simplicity and resultant ease of modification by the experimenters. The FOCAL program calculates the corrected intensity,

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<sup>3</sup>Trademark of Digital Equipment Corporation.

the electron distribution, average electron energy, and the plasma density. Average electron energy and plasma density are printed out. There is an optional print out of corrected intensities. The program now shifts to the four-decade display mode with the following options: raw data, corrected intensity as a function of energy, electron energy distribution, or all three. The options are obtained by pressing Sense Switch 1, 2, and 3, respectively. If more than one quarter of the multichannel analyzer is dumped, momentary pressing of sense Switch 5 will result in analysis of each quarter in turn; or if Switch 5 is left on, analysis proceeds automatically. When the last quarter has been analyzed, the program waits for another dump of the multichannel analyzer. Old data can be recalled from tape by another program at any time. (See Appendix 2, Program OLDATA.)

Appendix 1 contains a complete print out of the control program and the various subroutines. The control program also contains the interrupt routines, the routine for the HP analyzer dump, the temporary storage of raw data, and the statements for the Q & A display. A brief description of each subroutine follows. Some of the subroutines have names which indicate their original compositions, not their final version, i.e. DATA 256 originally handled 256 points, it now handles 1024.

DATA 256. This program converts the six digit BCD output of the analyzer to single precision floating point. It requires that the Dec routine SPFLT<sup>3</sup> be in core.

NEWPRNT. This subroutine contains a series of utility programs. These are: sample and store A-D converter outputs; CHANGE, a program which converts SPFLT for use by FOCAL and then converts FOCAL output for display; and print out routines for data tables, etc.

LOG 1024. Subroutine to take log of 1024 points as calculated by FOCAL and scale for display.

DISFOCA. This is the program for displaying the results on the CR display unit. The sense switch control routine mentioned above is in this subroutine.

Appendix 2 contains program OLDATA used to recover data from tape storage. Except for the data acquisition part, it is identical to

program CONTROL. However, since it is the raw data recalled, a modified version of the calculations could be used.

Appendix 3 contains program MODFOCA. This program allows the experimenter to modify his FOCAL program, then rewrite it on magnetic tape where program CONTROL or OLDDATA can read it into core.

Appendix 4 contains a description and wiring diagrams of the various interfaces used in the system.

#### MEMORY FIELD MAPS FOR FIGURES 1 - 4

Field  $\emptyset$ . The first of four 4 K memory banks contains addresses  $0000_8$  -  $7777_8$ . This is subdivided into LINC Instruction Fields (LIF) or LINC Data Fields (LDF) of  $1000_8$  locations. Each LIF or LDF is further subdivided into quarters. In Field  $\emptyset$  these are designated Q $\emptyset$ , Q1, Q2, and Q3. In all other fields the quarter designation is Q4, Q5, Q6, and Q7.

Field 1. Absolute addresses are  $10000_8$  -  $17777_8$ . Addresses within this field and all others or  $0000_8$  -  $7777_8$  as above. This field contains LDF 4, 5, 6, and 7 as this is the field used for data storage. Since each quarter of an LDF represents one LINC magnetic tape block, 16 blocks are required for storage of all data.

Field 2. Absolute addresses are  $20000_8$  -  $27777_8$  and LDF or LIF  $10_8$ ,  $11_8$ ,  $12_8$ , and  $13_8$ .

Field 3. Absolute addresses are  $30000_8$  -  $37777_8$  and LDF or LIF  $14_8$ ,  $15_8$ ,  $16_8$ , and  $17_8$ .

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## FIELD 0

0000 INTERRUPT ROUTINES FOR CONTROL LIFØ-QØ	400 OPEN LIFØ-Q1	2000 OPEN LIFØ1-QØ	2400 OPEN LIF1-Q1 2777
1000 OPEN LIFØ-Q2 1377	1400 OPEN LIFØ-Q3 1777	3000 OPEN LIF1-Q2	3400 HP SUBROUTINE 3655 OPEN LIF1Q-3 3777
4000 CONTROL PROGRAM LIF2-QØ	4400 SUBROUTINE NEWPRINT LIF2-Q1 4777	6000 OPEN LIF3-QØ	6400 LIF3-Q1 6777
5000 SUBROUTINE 1.-Q+A SUBROUTINE 2. NEWPRINT LIF2-Q2	7000 SUBROUTINE 2. NEWPRINT LIF2-Q3 5777	LIF3-Q2	7400 RESERVED FOR DIAL-MS LIF3-Q3 7777

Fig. 1. Core locations used in Field Ø.

ORNL-DWG 70-12634

FIELD 1

0000	Bremsstrahlung RAW DATA	2000	
LDF4-Q4	LDF4-Q5	LDF5-Q4	2nd CALCULATION
			LDF5-Q5
	1st CALCULATION		OPEN
LDF4-Q6	LDF4-Q7 1777	LDF5-Q6	LDF5-Q7 3777
4000	CONSTANTS USED IN CALCULATIONS	6000	
LDF6-Q4	LDF6-Q5	LDF7-Q4	EXPERIMENTAL CONDITIONS
			OPEN
LDF6-Q6	CONSTANTS USED IN CALCULATIONS	LDF7-Q6	RESERVED FOR DIAL-MS
	LDF7 Q7 5777		LDF7-Q7 7777

Fig. 2. Core locations used in Field 1 when one quarter of HP PHA is dumped.

ORNL-DWG 70-12635

## FIELD 2

ALL  
OF  
FIELD 2  
RESERVED  
FOR  
FOCAL

Fig. 3. Field 2 for FOCAL only.

ORNL-DWG 70-12636

## FIELD 3

0000	DATA 1024 (256)	2000	DIS FOCA
LDF 14-Q4	LIF-14-Q5	LIF-15 Q4	LIF-15-Q5
LOG4SCAL	SPFLT	OPEN	
LIF 14-Q6	LIF 14-Q7 1777	LDF-15-Q6	LDF 15-Q7 3777
4000		5000	
	LDF-16		LDF-17
	OPEN		OPEN
	5777		7777

Fig. 4. Core locations in Field 3.

## APPENDIX 1



PROGRAM CONTROL

```

0000 *20
0001 /CONTROL FOR INTEREM
0002 /USES A SYS TAPE
0003 /9-22-70
0004 /JE FRANCIS AND O C YONTS
0005 /INTERRUPT ROUTINE FOR H P ANALYZER
0006 PMODE
0007 *1
0010 0001 4003 JMS INRUP
0011 0002 7402 HLT
0012 0003 0000 INRUP, 0
0013 0004 6353 6353 /HP ANALYZER
0014 0005 7410 SKP
0015 0006 5425 JMP I ANAL
0016 0007 6041 6041 /TELEPRNT FLAG
0017 0010 7410 SKP
0020 0011 4017 JMS TELEPRNT
0021 0012 6031 6031
0022 0013 7410 SKP
0023 0014 4022 JMS READ
0024 0015 7000 NOP /FOR ION
0025 0016 5403 JMP I INRUP
0026 0017 0000 TELEPRNT, 0
0027 0020 6042 6042 /CLR FLAG
0030 0021 5417 JMP I TELEPRNT
0031 0022 0000 READ, 0
0032 0023 6032 6032 /CLR FLAG
0033 0024 5422 JMP I READ
0034 0025 3400 ANAL, 3400 /S R TO READ H P DATA
        ADDRS
0035 LMODE
0036 SEGMENT 0
0037 *40
0040 0040 0016 NOP
0041 0041 4074 STC ACSAV
0042 0042 0500 IOB
0043 0043 6234 RIB
0044 0044 0016 NOP
0045 0045 4075 STC EM
0046 0046 2040 ADD 0040
0047 0047 1620 BSE 1 /MAKE RETURN JMP
0050 0050 6000 6000
0051 0051 4072 STC RTN
0052 0052 0321 ROR I 1 /SAVE LINK BIT
0053 0053 4073 STC LINK
0054 0054 0002 PDP
0055 PMODE
0056 0055 4003 JMS INRUP
0057 0056 6141 LINC /RETURN L MODE
0060 LMODE
0061 0057 0016 NOP /FOR CHECK HLT
0062 0060 1000 LDA
0063 0061 0073 LINK
0064 0062 0261 ROL I 1 /RESTORE LINK
0065 0063 1000 LDA
0066 0064 0074 ACSAV
0067 0065 0500 IOB
0070 0066 6244 6244 /RMF
0071 0067 0500 IOB
0072 0070 7000 7000 /FOR ION
0073 0071 0006 DJR
0074 0072 0000 RTN, 0 /JMP CHANGE FIELD

```

0075	0073	0000	LINK,	0
0076	0074	0000	ACSAV,	0
0077	0075	0000	EM,	0
0100				ION=6001
0101				RIB=6234
0102				LMODE
0103				SEGMENT 1
0104				*20
0105	0020	1000	EXTRA,	LDA
0106	0021	0000		0
0107	0022	4101		STC EXIT TT+1
0110	0023	0642		LDF 2
0111	0024	1000		LDA
0112	0025	2377		RUNNUM
0113	0026	0244		ROL 4
0114	0027	4102		STC RUN
0115	0030	1000		LDA
0116	0031	2375		QN
0117	0032	1040		STA
0120	0033	0103		QUARTER
0121	0034	1120		ADA I
0122	0035	7776		-1
0123	0036	1040		STA
0124	0037	2375		QN
0125	0040	0647		LDF 7
0126	0041	1000		LDA
0127	0042	6034		6034 /H P WORD COUNT
0130	0043	1120		ADA I
0131	0044	7377		-400
0132	0045	0470		AZE I
0133	0046	6100		JMP EXIT TT
0134	0047	1040		STA
0135	0050	6034		6034
0136	0051	0544		LDF 4 /SET TO READ IN DATA
0137	0052	1000		LDA
0140	0053	0103		QUARTER
0141	0054	0017		COM
0142	0055	1120		ADA I
0143	0056	0005		5
0144	0057	0241		ROL 1
0145	0060	1140		ADM
0146	0061	0102		RUN /TAPE BN
0147	0062	1120		ADA I
0150	0063	4000		4000 /SPECIFY QN FIELD 1
0151	0064	1040		STA
0152	0065	0073		BN1
0153	0066	1120		ADA I
0154	0067	1001		1001
0155	0070	1040		STA
0156	0071	0075		BN2
0157	0072	0710		RDC U
0160	0073	0000	BN1,	0
0161	0074	0710		RDC U
0162	0075	0000	BN2,	0
0163	0076	0602		LIF 2
0164	0077	6214		JMP RENTER
0165	0100	0602	EXITT,	LIF 2
0166	0101	0000		0 /FOR ADDRS
0167	0102	0000	RUN,	0
0170				RUNNUM=377+2000
0171				QN=375+2000
0172	0103	0000	QUARTER,	0
0173				PMODE
				-

0174			*2240	
0175	2240	7000	NOP	/DO JMS TO THIS LOCAT
			ION TO GET TO FOCAL GO	
0176	2241	6221	CDF+20	
0177	2242	6222	CIF+20	
0200	2243	5644	JMP I STARTF	
0201	2244	7610	STARTF, 7610	
0202	2245	7000	NOP	
0203	2246	5640	JMP I .~6	
0204			/SUB ROUTINE FOR H P 5400 ANALYZER	
0205			/6 15 70 YONTS,FRANCIS	
0206			PMODE	
0207			*3400	
0210	3400	7000	HPGO, NOP	/SPACE FOR TLS WHEN
			USING ECHO	
0211	3401	4336	JMS DIG1	
0212	3402	1302	TAD S201	
0213	3403	7440	SZA	
0214	3404	5004	JMP INRUP+1	
0215	3405	7300	CLA CLL	
0216	3406	1320	TAD ADRS2	
0217	3407	3321	DCA TEMP	
0220	3410	1317	TAD ADRS1	
0221	3411	3335	DCA PERM	
0222	3412	1313	TAD C1	
0223	3413	3327	DCA COUNT1	
0224	3414	1314	TAD C2	
0225	3415	3330	DCA COUNT2	
0226	3416	1315	TAD C3	
0227	3417	3331	DCA COUNT3	
0230	3420	7000	NOP	
0231	3421	3332	DCA COUNT4	
0232	3422	1306	TAD C5	
0233	3423	3333	DCA COUNT5	
0234	3424	4336	JMS DIG1	/LOOK FOR CR
0235			/ASSUME CR	
0236	3425	4336	JMS DIG1	/LOOK FOR LF
0237	3426	1305	TAD NK12	
0240	3427	7440	SZA	
0241	3430	7402	HLT	
0242	3431	4336	JMS DIG1	/STORE STARTING PHA ME
			M LOCATION	
0243	3432	2321	ISZ TEMP	
0244	3433	3721	DCA I TEMP	
0245	3434	2327	ISZ COUNT1	
0246	3435	5231	JMP .~4	
0247	3436	1313	TAD C1	
0250	3437	3327	DCA COUNT1	
0251	3440	4336	START, JMS DIG1	
0252	3441	1307	TAD K1	
0253	3442	7450	SNA	/LOOK FOR CR
0254	3443	4360	JMS DIG2	/YES
0255	3444	1311	TAD K3	/NO RESTORE AC
0256	3445	1312	TAD K4	
0257			/AC SHOULD CONTAIN 240	
0260	3446	7440	SZA	/YES
0261	3447	7402	HLT	/NO
0262	3450	4336	BEGIN, JMS DIG1	/COLLECT AND PACK DIGI
			TS	
0263	3451	0326	AND MASK	
0264	3452	7006	RTL	
0265	3453	7006	RTL	
0266	3454	3703	DCA I TEMP2	

0261	3455	4336	JMS DIG1
0270	3456	0326	AND MASK
0271	3457	1703	TAD I TEMP2
0272	3460	7006	RTL
0273	3461	7006	RTL
0274	3462	3703	DCA I TEMP2
0275	3463	4336	JMS DIG1
0276	3464	0326	AND MASK
0277	3465	1703	TAD I TEMP2
0300	3466	6211	6211 /CDF1
0301			/NOP FOR 6211 LEAVES DATA IN FIELD 0
0302	3467	3735	DCA I PERM
0303	3470	2335	ISZ PERM
0304	3471	6201	6201 /CDF 0
0305			/NOP FOR FIELD 0
0306	3472	2330	ISZ COUNT2
0307	3473	5250	JMP BEGIN
0310	3474	1314	TAD C2
0311	3475	3330	DCA COUNT2
0312	3476	2332	ISZ COUNT4
0313	3477	5240	JMP START
0314	3500	5376	JMP EXIT
0315	3501	7402	STOP, HLT
0316	3502	7577	S201, -201
0317	3503	0000	TEMP2, 0
0320	3504	7574	NK204, -204
0321	3505	7766	NK12, -12
0322	3506	7773	C5, -5
0323	3507	7563	K1, -215
0324	3510	7766	K2, -12
0325	3511	0215	K3, 215
0326	3512	7540	K4, -240
0327	3513	7774	C1, -4
0330	3514	7776	C2, -2
0331	3515	7773	C3, -5
0332	3516	7000	C4, -1000
0333	3517	0000	ADRS1, 0000
0334	3520	3521	ADRS2, TEMP
0335	3521	0000	TEMP, 0
0336	3522	0000	0
0337	3523	0000	0
0340	3524	0000	0
0341	3525	0000	0
0342	3526	0017	MASK, 0017
0343	3527	0000	COUNT1, 0
0344	3530	0000	COUNT2, 0
0345	3531	0000	COUNT3, 0
0346	3532	0000	COUNT4, 0
0347	3533	0000	COUNT5, 0
0350	3534	0000	MES, 0
0351	3535	0000	PERM, 0
0352			/PERM IS STARTING ADRS OF DATA IN FIELD1
0353	3536	0000	DIG1, 0
0354	3537	7300	CLA CLL
0355	3540	6353	6353 /SKP FLAG2
0356	3541	5340	JMP +-1
0357	3542	6356	6356
0360	3543	3334	DCA MES
0361	3544	6352	6352 /CLEAR FLAGS
0362	3545	6357	6357 /FETCH NEXT
0363	3546	1334	TAD MES
0364	3547	7000	NOP /FOR TELETYPE ECHO
		INPUT	

0365	3550	7000	NOP
0366	3551	7000	NOP
0367	3552	1304	TAD NK204
0370	3553	7450	SNA
0371	3554	5376	JMP EXIT
0372	3555	7300	CLA CLL
0373	3556	1334	TAD MES
0374	3557	5736	JMP I DIG1
0375	3560	0000	DIG2,
0376	3561	4336	0
0377	3562	1305	JMS DIG1
0400	3563	7440	TAD NK12
0401	3564	7402	SZA
0402	3565	4336	HLT
0403	3566	2333	JMS DIG1
0404	3567	5365	ISZ COUNT5
0405	3570	3334	JMP +-2
0406	3571	1306	DCA MES
0407	3572	3333	TAD C5
0410	3573	1334	DGA COUNT5
0411	3574	1307	TAD MES
0412	3575	5760	TAD K1
0413	3576	7000	JMP I DIG2
0414		EXIT,	NOP
0415	3577	7000	/READ 10 CHARACTER TRAILER AND EXIT
0416			NOP
0417	3600	7300	*3600
0420	3601	1250	CLA CLL
0421	3602	3260	TAD NC12
0422	3603	6353	DCA COUNT6
0423	3604	5203	TRAIL,
0424	3605	6352	6353
0425	3606	6356	JMP +-1
0426	3607	6357	6352
0427	3610	7300	6356
0430	3611	2260	CLA CLL
0431	3612	5203	1SZ COUNT6
0432	3613	1254	JMP TRAIL
0433	3614	3656	TAD SC4
0434	3615	1254	DCA I DACALL
0435	3616	3655	TAD SC4
0436			DCA I QNCALL /QN INDEX FOR REWRITE
0437			//////////
0440			/FOLLOWING ROUTINE STORES HP STARTING
0441			/ADDRESS AND NUMBER OF POINTS STORED ON
0442			/TAPE.
0443	3617	1247	TAD NC4
0444	3620	3244	DCA CTN4
0445	3621	1251	TAD STRTEM
0446	3622	3252	DCA TEMLOC
0447	3623	1652	MOVLOC,
0448	3624	6211	TAD I TEMLOC
0449	3625	3653	CDF+10
0450	3626	6201	DCA I PRMLOC
0451	3627	2253	CDF 0
0452	3630	2252	1SZ PRMLOC
0453	3631	2244	1SZ TEMLOC
0454	3632	5223	1SZ CTN4
0455	3633	7300	JMP MOVLOC
0456	3634	1645	CLA CLL
0457	3635	6211	TAD I CA4
0458	3636	3653	CDF+10
0459	3637	6201	DCA I PRMLOC
0460	3640	7300	CDF 0
0461			CLA CLL

```

0464    3641  1246      TAD K6030
0465    3642  3253      DCA PRMLOC
0466    3643  5004      JMP INRUP+1
0467    3644  0000      CTN4,   0000
0470    3645  3532      CA4,   COUNT4
0471    3646  6030      K6030,  6030
0472    3647  7774      NC4,   -4
0473    3650  7766      NC12,  -12
0474    3651  0000      STRTEM, 0000
0475    3652  0000      TEMLOC, 0
0476    3653  6030      PRMLOC, 6030
0477    3654  0004      SC4,   4
0500    3655  4375      QNCALL, 4375
0501          ////////// STORE
0502    3656  4376      DACALL, 4376
0503    3657  2400      TRANS, 2400
0504    3660  0000      COUNT6, 0
0505          /PROGRAM CONTROL FOR INTERIM, USING
0506          /THE PDP-12.7-30-70
0507          LMODE
0510          SEGMENT 2
0511          *20
0512
0513          /INTEREM1
0514          SEGMENT 2
0515          *20
0516    0020  0700      RDC
0517    0021  2247      2247
0520    0022  0700      RDC
0521    0023  3250      3250
0522    0024  0647      LDF 7      /ANSWR TO GO IN FIELD
1
0523    0025  7000      JMP QAINIT
0524    0026  0032      TEST
0525    0027  6000      ANSR
0526    0030  7053      JMP QARFSH
0527          /GET CONDITIONS TO BE PUT HERE
0530    0031  6103      JMP LOAD
0531    0032  0640
0531    0033  1116
0531    0034  2405
0531    0035  2205
0531    0036  1540
0531    0037  0317
0531    0040  1624
0531    0041  2217
0531          TEST,   TEXT ZF INTEREM CONTROL
0532    0042  1443
0532    0043  4740
0532    0044  4040
0532
0533    0045  4040
0533    0046  4347
0533    0047  2025
0533    0050  2440
0533    0051  0140
0533    0052  0401
0533    0053  2401
0533    0054  4024
0533    0055  0120
0533    0056  0540
0533    0057  1716
0533    0060  4025
-
```

```

0533    0061  1611
0533                               PUT A DATA TAPE ON UNIT1
0534    0062  2461
0534    0063  4320
0534    0064  1405
0534    0065  0123
0534    0066  0540
0534    0067  2431
0534    0070  2005
0534    0071  4024
0534    0072  1005
0534    0073  4004
0534    0074  0124
0534    0075  0556
0534    0076  4074
0534    0077  6257
0534    0100  7462
0534    0101  5774
0534    0102  6234
0534                               PLEASE TYPE THE DATE. <2/<2/<2\Z
0535                               ANSR=6000
0536                               /ANSWR TO GO IN FIELD 1
0537                               QAINIT=1000
0540                               QARFSH=1053
0541    0103  0016 LOAD,   NOP           /LOAD REST OF SYS
0542                               /PROGRAM RDC FOCA MODIFIED FROM LINC-8
0543                               /FORMAT TO PDP-12 FORMAT. 7-31-70
0544                               ZTA=5
0545                               LMB=0600
0546                               UMB=0640
0547    0104  1020      LDA I
0550    0105  0700      RDC          /NOT INST
0551    0106  4331      STC DO      /TELL IT TO READ
0552    0107  1020      LDA I
0553    0110  3224      3224
0554    0111  4332      STC X2
0555    0112  0650      UMB 10
0556    0113  6320      JMP X1
0557    0114  1020      LDA I
0560    0115  3230      3230
0561    0116  4332      STC X2
0562    0117  0651      UMB 11
0563    0120  6320      JMP X1
0564    0121  1020      LDA I
0565    0122  3234      3234
0566    0123  4332      STC X2
0567    0124  0652      UMB 12
0570    0125  6320      JMP X1
0571    0126  1020      LDA I
0572    0127  3240      3240
0573    0130  4332      STC X2
0574    0131  0653      UMB 13
0575    0132  6320      JMP X1
0576                               ////END RDC FOCA
0577                               ///LOAD DATA 256 FROM TAPE
0600    0133  0654      LDF 14
0601    0134  0700      RDC
0602    0135  5263      5263
0603                               ///END DATA256
0604                               ///LOAD LOG4SCALE
0605    0136  0700      RDC
0606    0137  6265      6265
0607                               ///END L4S
-
```

```

0610      ///LOAD SPFLT
0611 0140 0700     RDC
0612 0141 7267     7267
0613      ///END SPFLT
0614      ///LOAD DIS FOCA PART 1
0615 0142 0655     LDF 15
0616 0143 0700     RDC
0617 0144 4252     4252
0620      ///LOAD DIS FOCA PART 2
0621 0145 0700     RDC
0622 0146 5253     5253
0623      ///END DIS FOCA
0624      ///LOAD THREE BLOCKS OF NEWPRINT FOR PRINTOUT
0625 0147 0700     RDC
0626 0150 1257     1257      /PRNTOUT 3BLKS
0627 0151 0700     RDC
0630 0152 2260     2260      /PRNTOUT
0631 0153 0700     RDC
0632 0154 3261     3261      /PRNTOUT
0633      ///LOAD FNEW CONSTANTS
0634 0155 0646     LDF 6
0635 0156 0700     RDC
0636 0157 4270     4270
0637 0160 0700     RDC
0640 0161 5271     5271
0641 0162 0700     RDC
0642 0163 6272     6272
0643 0164 0700     RDC
0644 0165 7273     7273
0645 0166 0644     LDF 4
0646      /DATA STORAGE AREA
0647 0167 0002     LOOK, PDP      /8MODE FOR ION
0650          PMODE
0651 4170 6042     TCF      /PREVENT TTY FROM CAU
          SING INTERRUPT
0652 4171 6001     ION
0653 4172 7000     NOP      /TO GET ION
0654 4173 6141     LINC      /RETURN TO LINC
0655          LMODE
0656 0174 6202     CHECK, JMP LNCALL
0657 0175 0465     SNS I 5
0660 0176 6400     JMP CONDIT
0661 0177 0465     SNS I 5
0662 0200 7000     JMP PRNTOU
0663 0201 6174     JMP CHECK
          CONDIT=400
0664          PRNTOU=1000
0666 0202 1000     LNCALL, LDA
0667 0203 0376     CALL
0670 0204 0470     AZE I
0671 0205 6000     JMP 0
0672 0206 0011     CLR
0673 0207 4376     STC CALL
0674          /CLEAR LNCALL
0675 0210 6400     JMP CONDIT      /PART OF PRNTOUT
0676 0211 0614     FLOAT, LIF 14
0677          /GO TO DATA EM
0700 0212 6400     JMP 400
0701          /PART OF NEWPRNT SOURCE
0702 0213 6252     JMP WRDATA      /UPDATE AND WRC DATA
0703 0214 7000     RENTER, JMP PRNTOU
0704 0215 6500     JMP CHANGE
          CHANGE=500
-
```

0706 /PART OF NEWPRNT SOURCE  
 0707 /REVERSE FOR FOCAL! INTERCHANGE  
 0710 /MANTISSE AND EXPONENT FOR FOCAL  
 0711 0216 0500 10B  
 0712 0217 6002 6002 /IOF FOR FOCAL IN FIE  
 LD 2  
 0713 0220 6240 JMP FOCAL  
 0714 0221 6500 JMP CHANGE /CHANGE BACK  
 0715 /FOR SPFLPT  
 0716 /GET LOG  
 0717 0222 0614 LIF 14  
 0720 0223 7000 JMP 1000  
 0721 0224 0500 10B  
 0722 0225 6042 6042  
 0723 0226 0500 10B  
 0724 0227 6001 6001 /CLR TTY AND ION  
 0725 /HIT THAT OLD DISPLAY  
 0726 0230 0615 LIF 15  
 0727 0231 6020 JMP 20  
 0730 0232 6202 JMP LNCALL  
 0731 0233 0601 LIF 1  
 0732 0234 6020 JMP EXTRA  
 0733 0235 6167 JMP LOOK  
 0734 0236 0000 HLT /FOR CHECK  
 0735 0237 2240 FOCAGO, 2240 /THIS LOCATION FOR RE  
 TURN FROM FOCAL  
 0736 /THE FOCAL EXIT CAN BE CHANGED  
 0737 0240 0011 FOCAL, CLR  
 0740 0241 2000 ADD 0  
 0741 0242 4251 STC EX1  
 0742 0243 0002 PDP  
 0743 PMODE  
 0744 4244 4637 JMS I FOCAGO  
 0745 4245 7000 NOP  
 0746 4246 6141 LINC  
 0747 LMODE  
 0750 0247 0644 LDF 4  
 0751 0250 0602 LIF 2 /RESET DATA FIELD AND  
 INST FOR CONTROL  
 0752 0251 0000 EX1, 0  
 0753 /PROGRAM TO WRITE DATA ON TAPE.  
 0754 /PROGRAM WRITES ALL OF FIELD1 ON TAPE 1  
 0755 0252 1000 WRDATA, LDA  
 0756 0253 0000 0  
 0757 0254 4317 STC EX2  
 0760 0255 1020 LDA I  
 0761 0256 0714 WRC U  
 0762 0257 4331 STC DO  
 0763 0260 1020 LDA I  
 0764 0261 0001 1  
 0765 0262 1140 ADM  
 0766 0263 0377 RUNNU  
 0767 0264 0647 LDF 7  
 0770 0265 1040 STA  
 0771 0266 6173 6173 /RUN NUM ON TAPE IN F  
 FIELD 1  
 0772 0267 0244 ROL 4  
 0773 0270 1120 ADA I  
 0774 0271 7776 -1  
 0775 0272 1620 BSE I  
 0776 0273 3000 3000  
 0777 0274 1040 STA  
 1000 0275 0332 X2

```

1001      /CHECK TAPE FULL
1002      0276  1560      BCL I
1003      0277  7000      7000
1004      0300  0016      NOP
1005      0301  1120      ADA I
1006      0302  7021      -756
1007      0303  0471      APO I
1010      0304  0000      HLT
1011      /UPDATE RUNNU ON CONTROL TAPE
1012      0305  0704      WRC
1013      0306  0223      0223
1014      0307  0644      LDF 4
1015      0310  6320      JMP X1
1016      0311  0645      LDF 5
1017      0312  6320      JMP X1
1020      0313  0646      LDF 6
1021      0314  6320      JMP X1
1022      0315  0647      LDF 7
1023      0316  6320      JMP X1
1024      0317  0000      EX2.  0
1025      0320  1000      X1,   LDA
1026      0321  0000      0
1027      0322  4344      STC X4
1030      0323  0065      SET I 5
1031      0324  7773      -4
1032      0325  1020      X3,   LDA I
1033      0326  1001      1001
1034      0327  1140      ADM
1035      0330  0332      X2
1036      0331  0016      DO,   NOP
1037      0332  0000      X2,   0
1040      0333  0225      XSK I 5
1041      0334  6325      JMP X3
1042      0335  1000      LDA
1043      0336  0332      X2
1044      0337  1560      BCL I
1045      0340  7000      7000      /RESET FOR QN
1046      0341  1620      BSE I
1047      0342  3000      3000
1050      0343  4332      STC X2
1051      0344  0000      X4,   0
1052      *375
1053      0375  0000      QNX,   0      /FOR INDEXING H P QUA
1054      0376  0000      RTERS
1055
1056      0377  0000      CALL,   0
1057      ///////////////////////////////////////////////////////////////////
1060      ///////////////////////////////////////////////////////////////////
1061      ///////////////////////////////////////////////////////////////////
1062      ///////////////////////////////////////////////////////////////////
1063      ///////////////////////////////////////////////////////////////////
1064      ///////////////////////////////////////////////////////////////////
1065      ///////////////////////////////////////////////////////////////////

```

NO ERRORS

```

ACSAV  0074
ADRS1  3517
ADRS2  3520
ANAL   0025
ANSR   6000
BEGIN  3450
-

```

BN1 2073  
BN2 2075  
CALL 4376  
CA4 3645  
CHANGE 0500  
CHECK 4174  
CONDIT 0400  
COUNT1 3527  
COUNT2 3530  
COUNT3 3531  
COUNT4 3532  
COUNT5 3533  
COUNT6 3660  
CTN4 3644  
C1 3513  
C2 3514  
C3 3515  
C4 3516  
C5 3506  
DACALL 3656  
DIG1 3536  
DIG2 3560  
DO 4331  
EM 0075  
EXIT 3576  
EXITT 2100  
EXTRA 2020  
EX1 4251  
EX2 4317  
FLOAT 4211  
FOCAGO 4237  
FOCAL 4240  
HPGO 3400  
INRUP 0003  
ION 6001  
K1 3507  
K2 3510  
K3 3511  
K4 3512  
X6030 3646  
LINK 0073  
LMB 0600  
LNCALL 4202  
LOAD 4103  
LOOK 4167  
MASK 3526  
MES 3534  
MOVLOC 3623  
NC12 3650  
NC4 3647  
NK12 3505  
NK204 3504  
PERM 3535  
PRMLOC 3653  
PBNTOU 1000  
QAINIT 1000  
QARFSH 1053  
QN 2375  
QNCALL 3655  
QNX 4375  
QUARTE 2103  
READ 0022  
REENTER 4214

RIB	6234
RTN	0072
RUN	2102
RUNNU	4377
RUNNUM	2377
SC4	3654
START	3440
STARTF	2244
STOP	3501
STRTEM	3651
S201	3502
TELEPR	0017
TEMLOC	3652
TEMP	3521
TEMP2	3503
TEST	4032
TRAIL.	3603
TRANS	3657
UMB	0640
VRDATA	4252
X1	4320
X2	4332
X3	4325
X4	4344
Z RA	0005

```

0000          *20
0001          /PROGRAM NEWPRNT 10-9-70
0002          /PROGRAM TO READ CONDITIONS ON
0003          /INTEREM OR IMP DEPENDING ON CODE.
0004          SEGMENT 2
0005          *400
0006    0400  1000  CONDIT, LDA
0007    0401  0000      0
0010    0402  4441      STC EX6
0011    0403  1020      LDA I
0012    0404  0100      SAM 0      /NOT AN INSTR
0013    0405  4413      STC CHAN
0014    0406  0065      SET I 5
0015    0407  7740      -37
0016    0410  0066      SET I 6
0017    0411  6077      6100-1      /ADDR FOR A-D DATA ST
0020          ORAGE
0021    0412  0647      LDF 7      /IN FIELD1
0022    0413  0100      CHAN, SAM 0
0023    0414  1066      STA I 6
0024    0415  1020      LDA I
0025    0416  0001      1
0026    0417  1140      ADM
0027    0420  0413      CHAN
0028    0421  0225      XSK I 5
0029    0422  6413      JMP CHAN
0031    0423  0066      SET I 6
0032    0424  6173      6173      /CODE-1
0033    0425  0011      CLR
0034    0426  0500      IOB
0035    0427  6361      6361
0036    0430  1066      STA I 6
0037    0431  0011      CLR
0038    0432  0500      IOB
0039    0433  6362      6362
0040    0434  1066      STA I 6
0041    0435  0011      CLR
0042    0436  0500      IOB
0043    0437  6364      6364
0046          /CODE WORDS STORED HERE
0047    0440  1066      STA I 6
0050    0441  0000      EX6, 0      /RETURN TO MAIN PROGR
AM
0051          /CHANGE FOR FOCAL TO SPFLT FORMAT
0052          *500
0053    0500  1000      CHANGE, LDA
0054    0501  0000      0
0055    0502  4600      STC S2
0056    0503  6533      JMP SR9      /CHANGE 1024PTS
0057    0504  0647      LDF 7
0058    0505  1000      LDA
0061    0506  6034      POINT
0062          POINT=6034      /HP WORD COUNT
0063    0507  0017      COM
0064    0510  0644      LDF 4
0065    0511  1460      SAE I
0066    0512  7377      -400
0067    0513  0456      SKP
0070    0514  6525      JMP SR7
0071    0515  1460      SAE I
0072    0516  6777      -1000
0073    0517  0456      SKP

```

```

0074    0520  6530      JMP SR8
0075    0521  1460      SAE I
0076    0522  5777      -2000
0077    0523  0000      HLT           /ERROR
0100    0524  6533      JMP SR9
0101    0525  4556      SR7,       STC NUM2
0102    0526  6546      JMP CHNG
0103    0527  6600      JMP S2           /GO EXIT
0104    0530  4556      SR8,       STC NUM2
0105    0531  6546      JMP CHNG
0106    0532  6600      JMP S2
0107    0533  1020      SR9,       LDA I
0110    0534  6777      -1000
0111    0535  4556      STC NUM2
0112    0536  6546      JMP CHNG
0113    0537  1020      LDA I
0114    0540  6777      -1000
0115    0541  4556      STC NUM2
0116    0542  0645      LDF 5           /FOR NEXT 1000
0117    0543  6546      JMP CHNG
0120    0544  0644      LDF 4           /RESTORE DF
0121    0545  6600      JMP S2
0122    0546  1000      CHNG,       LDA
0123    0547  0000      0
0124    0550  4577      STC EXITSR
0125    0551  0065      SET I 5
0126    0552  3777      3777
0127    0553  0064      SET I 4
0130    0554  2000      2000
0131    0555  0067      SET I 7
0132    0556  7377      NUM2,       -400
0133    0557  0016      NOP
0134    0560  1025      T2,        LDA I 5
0135    0561  4601      STC T3           /STORE TEMP
0136    0562  1025      LDA I 5
0137    0563  1044      STA 4
0140    0564  0016      NOP
0141    0565  1000      LDA
0142    0566  0601      T3
0143    0567  1045      STA 5
0144    0570  0016      NOP
0145    0571  1020      LDA I
0146    0572  0002      2
0147    0573  1140      ADM
0150    0574  0004      4
0151    0575  0227      XSK I 7
0152    0576  6560      JMP T2
0153    0577  0000      EXITSR, 0
0154    0600  1405      S2,        EXIT
0155    0601  0000      T3,        0           /TEMP STORAGE
0156          //////////////DANGER/////////
0157          //// THIS PROGRAM WRITES ON TAPE UNIT 1
0160          //BE SURE DATA TAPE IS ON TAPE UNIT 1
0161          ////DANGER
0162          SEGMENT 2
0163          /PRNTOUT
0164          /8 21 70
0165          / TEXT FOR IMP DATA TABLE
0166          *1000
0167    1000  1000      PRNTOU, LDA
0170    1001  0000      0
0171    1002  5343      STC EXITP
0172    1003  0500      IOB
-
```

0173	1004	6002	6002	/IOF
0174	1005	0500	I0B	
0175	1006	6046	6046	/CAN BE DELETED WHEN ASSEMBLED WITH ANOTHER
0176			/GET CONDITIONS TO BE PUT HERE	
0177	1007	0070	SET I 10	
0200	1010	5343	TITLE3+4000-1	
0201	1011	1330	LOOP, LDH I 10	
0202	1012	7423	JMP TY	
0203	1013	1000	LDA	
0204	1014	0010	10	
0205	1015	1460	SAE I	
0206	1016	1403	STOP3-1	
0207	1017	7011	JMP LOOP	
0210	1020	0070	SET I 10	
0211	1021	6000	ANSR	
0212			ANSR=6000	/IN FIELD 1
0213	1022	0647	LDF 7	/TO BE IN RIGHT FIELD
0214	1023	1330	LDH I 10	
0215	1024	7423	JMP TY	
0216	1025	1330	LDH I 10	
0217	1026	1460	SAE I	
0220	1027	0034	0034	
0221	1030	7024	JMP .-4	/4 INST NOT LOCATIONS
0222	1031	1020	LDA I	
0223	1032	0004	4	
0224	1033	7406	JMP SPACES	
0225	1034	1000	LDA	
0226	1035	6173	6173	/RUNNU FOR TAPE STORE
		D HERE		
0227	1036	5672	STC V5	
0230	1037	7504	JMP V1	
0231			/MICROWAVE POWER	
0232			/SCALE DETERMINED BY SW SETTING	
0233			/9 18 70	
0234	1040	1020	LDA I	
0235	1041	0003	3	
0236	1042	7406	JMP SPACES	
0237	1043	0647	LDF 7	
0240	1044	1000	LDA	
0241	1045	6111	AD+11	/MICR POWR 1
0242	1046	0016	NOP	
0243	1047	5672	STC V5	
0244	1050	1000	LDA	
0245			/GET SCALE CODE	
0246	1051	6176	CODE+2	
0247	1052	1560	BCL I	
0250	1053	0777	0777	
0251	1054	0243	ROL 3	
0252	1055	0470	AZE I	
0253	1056	7102	JMP G1	
0254	1057	3165	ADD C2	
0255	1060	0470	AZE I	
0256	1061	7115	JMP G2	
0257	1062	3165	ADD C2	
0260	1063	0470	AZE I	
0261	1064	7125	JMP G3	
0262	1065	3165	ADD C2	
0263	1066	0470	AZE I	
0264	1067	7132	JMP G4	
0265	1070	3165	ADD C2	
0266	1071	0470	AZE I	
0267	1072	7137	JMP G5	

0270	1073	3165	ADD C2
0271	1074	0470	AZE I
0272	1075	7141	JMP G6
0273	1076	3165	ADD C2
0274	1077	0470	AZE I
0275	1100	7137	JMP G5
0276	1101	0000	HLT /NO CODE
0277	1102	7143	G1, JMP R1
0300			/PRNT TRAILING ZEROS
0301	1103	1020	LDA I
0302	1104	0060	60
0303	1105	7423	JMP TY
0304	1106	1020	LDA I
0305	1107	0060	60
0306	1110	7423	JMP TY
0307	1111	1020	LDA I
0310	1112	0060	60
0311	1113	7423	JMP TY
0312	1114	7166	JMP E4
0313	1115	7150	G2, JMP R2
0314	1116	1020	LDA I
0315	1117	0060	60
0316	1120	7423	JMP TY
0317	1121	1020	LDA I
0320	1122	0060	60
0321	1123	7423	JMP TY
0322	1124	7166	JMP E4
0323	1125	7143	G3, JMP R1
0324	1126	1020	LDA I
0325	1127	0060	60
0326	1130	7423	JMP TY
0327	1131	7166	JMP E4
0330	1132	7150	G4, JMP R2
0331	1133	1020	LDA I
0332	1134	0060	60
0333	1135	7423	JMP TY
0334	1136	7166	JMP E4
0335	1137	7143	G5, JMP R1
0336	1140	7166	JMP E4
0337	1141	7150	G6, JMP R2
0340	1142	7166	JMP E4
0341	1143	1000	R1, LDA
0342	1144	0000	0
0343	1145	5147	STC NX
0344	1146	7504	JMP V1
0345	1147	0000	NX, 0
0346	1150	1000	R2, LDA
0347	1151	0000	0
0350	1152	5162	STC NX2
0351	1153	1000	LDA
0352	1154	1672	V5
0353	1155	0342	SCR 2
0354	1156	3672	ADD V5
0355	1157	0342	SCR 2
0356	1160	5672	STC V5
0357	1161	7504	JMP V1
0360	1162	0000	NX2, 0
0361	1163	0000	HLT
0362	1164	6010	JMP 10
0363	1165	7776	C2, -1
0364	1166	0016	E4, NOP /EXIT
0365	1167	0644	LDF 4 /RESET DATA FIELD
0366			/SPACES FOR POWER2//////////

```

0367 1170 1020      LDA I
0370 1171 0004      4
0371 1172 7406      JMP SPACES
0372 1173 0647      LDF 7
0373 1174 1000      LDA
0374 1175 6113      AD+13      /GET PWR
0375 1176 0241      ROL 1      /TIMES TWO
0376 1177 5672      STC V5
0377 1200 7504      JMP V1
0400 1201 1020      LDA I
0401 1202 0004      4
0402 1203 7406      JMP SPACES
0403          /PRINT FIELD CURRENTS
0404 1204 0647      LDF 7
0405 1205 1000      LDA
0406 1206 6110      AD+10
0407 1207 0241      ROL 1
0410 1210 5672      STC V5
0411 1211 7504      JMP V1
0412 1212 1020      LDA I
0413 1213 0060      60
0414 1214 7423      JMP TY
0415 1215 1020      LDA I
0416 1216 0003      3
0417 1217 7406      JMP SPACES
0420          /PRNT J FIELD
0421 1220 1000      LDA
0422 1221 6112      AD+12
0423 1222 0241      ROL 1
0424 1223 5672      STC V5
0425 1224 7504      JMP V1
0426 1225 1020      LDA I
0427 1226 0060      60
0430 1227 7423      JMP TY
0431 1230 1020      LDA I
0432 1231 0003      3
0433 1232 7406      JMP SPACES
0434          /PRINT INTEREM PRES
0435          /FOR INTEREM
0436 1233 0647      LDF 7      /DATA HERE
0437          AD=6100      /START OF AD DATA
0440 1234 1000      LDA
0441 1235 6176      CODE+2
0442          CODE=6174
0443 1236 0342      SCR 2      /LINE UP FACTOR BITS
0444 1237 0017      COM
0445 1240 1560      BCL I
0446 1241 7774      7774
0447 1242 1120      ADA I
0450 1243 0005      5
0451 1244 5323      STC FACTOR
0452 1245 1000      LDA
0453 1246 6114      AD+14      /PRES IN CHAN 14
0454 1247 0017      COM
0455 1250 0342      SCR 2
0456 1251 5672      STC V5
0457 1252 1000      LDA
0460 1253 6176      CODE+2
0461 1254 0345      SCR 5
0462 1255 1560      BCL I
0463 1256 7774      7774
0464 1257 0470      AZE I

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0465 1260 7277      JMP Z2
0466 1261 1120      ADA I
0467 1262 7776      -1
0470 1263 0470      AZE I
0471 1264 7272      JMP Z4
0472 1265 1120      ADA I
0473 1266 7776      -1
0474 1267 0470      AZE I
0475 1270 7313      JMP Z1
0476 1271 7310      JMP Z3
0477 1272 1000 Z4,   LDA /X 2 SCALE
0500 1273 1672      V5
0501 1274 0341      SCR 1
0502 1275 5672      STC V5
0503 1276 7313      JMP Z1
0504 1277 1000 Z2,   LDA / X 5 SCALE
0505 1300 1672      V5
0506 1301 0241      ROL 1
0507 1302 5672      STC V5
0510 1303 1020      LDA I /CHANGE SCALE FACTOR BY 1
0511 1304 0001      1
0512 1305 1140      ADM
0513 1306 1323      FACTOR
0514 1307 7313      JMP Z1
0515 1310 1020 Z3,   LDA I /GAUGE OFF WRITE XX
0516 1311 7747      -30          /60-30=X
0517 1312 5323      STC FACTOR
0520 1313 7504 Z1,   JMP V1
0521 /PRINT PRES
0522 1314 1020      LDA I
0523 1315 0005      5           /PRNT E
0524 1316 7423      JMP TY
0525 1317 1020      LDA I
0526 1320 0055      55          /PRNT MINUS
0527 1321 7423      JMP TY
0530 1322 1020      LDA I      /LOAD FACTOR
0531 1323 0000 FACTOR, 0
0532 1324 1120      ADA I
0533 1325 0060      60          /MAKE 12 CODE NUM
0534 1326 7423      JMP TY
0535 1327 0644      LDF 4      /RESTORE LINC DATA FILE
LD
0536 ///////////////CONTINUE PROGRAM HERE
0537 ////////////JMP LEAVE TO RETURN TO MAIN PROGRAM
0540 1330 0016 LEAVE, NOP
0541 1331 0500 IOB
0542 1332 6041 6041          /WAIT FOR FLAG FOR TL
S IN TY
0543 1333 7331      JMP --2
0544 1334 0500 IOB
0545 1335 6042 6042          /CLR TTY
0546 1336 0500 IOB
0547 1337 6001 6001          /ION
0550 1340 0016 NOP          /INTERRUPT BACK ON
0551 1341 0644 LDF 4      /RESET DATA FIELD
0552 1342 7343      JMP EXITP
0553 1343 0000 EXITP,0      /RETURN TO PROGRAM
0554 TITLE3, TEXT Z
0555 1344 4043
0555 1345 4004
0555 1346 0124
0555 1347 0540
0555 1350 4040
-

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0555	1351	4040						
0555	1352	2225						
0555	1353	1640						
0555	1354	1617						
0555	1355	5640						
0555	1356	4040						
0555	1357	2027						
0555	1360	2240						
0555	1361	6140						
0555	1362	4040						
0555	1363	4020						
0555	1364	2722						
0555	1365	4062						
0555	1366	4040						
0555	1367	4015						
0555	1370	0611						
0555	1371	0514						
0555	1372	0440						
0555	1373	4040						
0555	1374	1206						
0555	1375	1105						
0555	1376	1404						
0555	1377	4040						
0555	1400	2022						
0555	1401	0523						
0555			DATE	RUN NO.	PWR 1	PWR 2	MFIELD	JF
0555			I ELD	PRESS				
0556	1402	2343						
0556			Z					
0557	1403	0016	NOP					
0560	1404	0000	STOP3, HLT					
0561	1405	0000	EXIT, 0					
0562			/SPACE ROUTINE					
0563	1406	0016	SPACES, NOP					
0564			/SET NO SPACES					
0565	1407	0017	COM					
0566	1410	5414	STC SPNUM					
0567	1411	2000	ADD 0					
0570	1412	5422	STC EXITS					
0571	1413	0065	SET I 5					
0572	1414	0000	SPNUM, 0					
0573	1415	1020	LDA I					
0574	1416	0040	40					
0575	1417	7423	JMP TY					
0576	1420	0225	XSK I 5					
0577	1421	7415	JMP SPNUM+1					
0600	1422	0000	EXITS, 0					
0601			/TYPR SUBROUTINE					
0602	1423	0057	TY, SET 17					
0603	1424	0000	0					
0604	1425	5501	STC TEMP					
0605	1426	1000	LDA					
0606	1427	1501	TEMP					
0607			/CHK LINE FEED					
0610	1430	1460	SAE I					
0611	1431	0043	43					
0612	1432	7434	JMP +2					
0613	1433	7462	JMP CR					
0614	1434	3503	ADD C37					
0615	1435	0451	APO					
0616	1436	7455	JMP LETR					
0617	1437	3502	ADD C20					
0620	1440	0451	APO					
			/LETTER CODE					

0621	1441	7474	JMP SPES	/SPECIAL CHARACTER
0622	1442	1000	LDA	/FORM NUM
0623	1443	1501	TEMP	
0624	1444	1120	ADA I	
0625	1445	0200	200	
0626	1446	7447	JMP PRINT	
0627	1447	0500	PRINT,	I0B
0630	1450	6041		6041
0631	1451	7447	JMP .-2	
0632	1452	0500		I0B
0633	1453	6046		6046
0634	1454	6017	JMP 17	/EXIT
0635	1455	1000	LETR,	LDA
0636	1456	1501	TEMP	
0637	1457	1120	ADA I	
0640	1460	0300		300
0641	1461	7447	JMP PRINT	
0642	1462	1020	CR,	LDA I
0643	1463	0215		215
0644	1464	0500		I0B
0645	1465	6041		6041
0646	1466	7464	JMP .-2	
0647	1467	0500		I0B
0650	1470	6046		6046
0651	1471	1020		LDA I
0652	1472	0212		212
0653	1473	7447	JMP PRINT	
0654	1474	1000	SPES,	LDA
0655	1475	1501	TEMP	
0656	1476	1120	ADA I	
0657	1477	0200		200
0660	1500	7447	JMP PRINT	
0661	1501	0000	TEMP,	0
0662	1502	7757	C20,	-20
0663	1503	7740	C37,	-37
0664			/SUB TO GO BINARY TO BCD\	
0665			/ANSR IN L1 AND NEXT THREE BINS	
0666			/8 1 68	
0667			/ENTER WITH NO. TO BE CV IN 5V	
0670			/BINARY TO DECIMAL	
0671	1504	0011	V1,	CLR
0672	1505	2000		ADD 0
0673	1506	5612	STC V3	
0674	1507	0071	SET I 11	
0675	1510	1664	L1-1	
0676	1511	1020	LDA I	
0677	1512	1672	V5	
0700	1513	1040	STA	
0701	1514	1630	S4	
0702	1515	1040	STA	
0703	1516	1624	S3	
0704	1517	1000	LDA	
0705	1520	1664	Y4+2	
0706	1521	1040	STA	
0707	1522	1643	S5	
0710	1523	0017	COM	
0711	1524	5626	STC S4-2	
0712	1525	7615	JMP V2	
0713	1526	1000	LDA	
0714	1527	1657	Y1	
0715	1530	1071	STA I 9	
0716	1531	1020	LDA I	
0717	1532	1661	Y3	

0720	1533	1040	STA
0721	1534	1630	S4
0722	1535	1040	STA
0723	1536	1624	S3
0724	1537	1000	LDA
0725	1540	1663	Y4+1
0726	1541	1040	STA
0727	1542	1643	S5
0730	1543	0017	COM
0731	1544	5626	STC S4-2
0732	1545	7615	JMP V2
0733	1546	1000	LDA
0734	1547	1657	Y1
0735	1550	1071	STA I 9
0736	1551	1020	LDA I
0737	1552	1661	Y3
0740	1553	1040	STA
0741	1554	1630	S4
0742	1555	1040	STA
0743	1556	1624	S3
0744	1557	1000	LDA
0745	1560	1662	Y4
0746	1561	1040	STA
0747	1562	1643	S5
0750	1563	0017	COM
0751	1564	5626	STC S4-2
0752	1565	7615	JMP V2
0753	1566	1000	LDA
0754	1567	1657	Y1
0755	1570	1071	STA I 9
0756	1571	1000	LDA
0757	1572	1661	Y3
0760	1573	1460	SAE I
0761	1574	7777	7777
0762	1575	0456	SKP /SKP UNCONDITIONAL
0763	1576	0017	COM /TAKECARE OF MINUS ZERO
0764	1577	1071	STA I 9
0765	1600	0070	SET I 10
0766	1601	1664	L1-1
0767	1602	0076	SET I 16
0770	1603	7773	-4
0771	1604	1030	NO,
0772	1605	1120	ADA I
0773	1606	0060	60
			/FORM 12 CODE FOR TYP
		E	
0774	1607	7423	JMP TY
0775	1610	0236	XSK I 16
0776	1611	7604	JMP NO
0777	1612	0000	V3, 0 /EXIT
1000	1613	0000	0000 /EXIT
1001	1614	0000	Q7, 0 /TEMP STORE
1002			/OCTALL NO. TO HOW MANY X,S
1003	1615	0011	V2, CLR
1004	1616	5657	STC Y1
1005	1617	2000	ADD 0
1006	1620	5656	STC V4
1007	1621	0011	CLR
1010	1622	5657	STC Y1
1011	1623	1000	LDA
1012	1624	0000	S3, 0 /ADDRS OCTAL NO.
1013	1625	1120	ADA I
1014	1626	0000	0 /FACTOR -X
1015	1627	1040	STA

1016	1630	0000	S4,	0	/ADDRS OCTAL NO.
1017	1631	0451		APO	
1020	1632	7640		JMP	*+6
1021	1633	1020		LDA	I
1022	1634	0001			1
1023	1635	1140		A·M	
1024	1636	1657		Y1	
1025	1637	7623		J·P	V2+6
1026	1640	1470		AZE	I
1027	1641	7645		JMP	*+4
1030	1642	1120		A·A	I
1031	1643	0000	S5,	0	/FACTOR X
1032	1644	7652		JMP	*+6
1033	1645	1020		LDA	I
1034	1646	0001			1
1045	1647	1140		A·M	
1036	1650	1657		Y1	
1037	1651	0011		CLR	
1040	1652	5660		STC	Y2
1041	1653	3660		ADD	Y2
1042	1654	1040		STA	
1043	1655	1661		Y3	/CONTAINS LEFT OVER NO
1044	1656	0000	V4,	0	
1045				/EXIT	
1046	1657	0000	Y1,	0	
1047	1660	0000	Y2,	0	
1050	1661	0000	Y3,	0	
1051	1662	0012	Y4,	12	
1052	1663	0144		144	
1053	1664	1750		1750	/FACTORS TO GET DECIMAL
1054	1665	0000	L1,		00/ THESE FOR SPACES TEMP STORAGE OF DI
			GITS		
1055	1666	0000		00	
1056	1667	0000		00	
1057	1670	0000		00	
1060	1671	0000		00	
1061	1672	0000	V5,	0	/TEMP STORE NO. TO BE
			CV		
1062				RUNNU=377	/RUN NO. STORED HERE
1063				/CHANGES 1024	
1064				/DELETE LN 60	FOR CONTROL QUARTERS

NO ERRORS

AD	6100
ANSR	6000
CHAN	4413
CHANGE	4500
CHNG	4546
CODE	6174
CONDIT	4400
CR	5462
C2	5165
C20	5502
C37	5503
EXIT	5405
EXITP	5343
EXITS	5422
EXITSR	4577
EX6	4441
E4	5166
FACTOR	5323
G1	5102

G2	5115
G3	5125
G4	5132
G5	5137
G6	5141
LEAVE	5330
LETR	5455
LOOP	5011
L1	5665
NO	5604
NUM2	4556
NX	5147
NX2	5162
POINT	6034
PRINT	5447
PRNTOU	5000
Q7	5614
RUNNU	0377
R1	5143
R2	5150
SPACES	5406
SPES	5474
SPNUM	5414
SR7	4525
SR8	4530
SR9	4533
STOP3	5404
S2	4600
S3	5624
S4	5630
S5	5643
TEMP	5501
TITLE3	5344
TY	5423
T2	4560
T3	4601
V1	5504
V2	5615
V3	5612
V4	5656
V5	5672
Y1	5657
Y2	5660
Y3	5661
Y4	5662
Z1	5313
Z2	5277
Z3	5310
Z4	5272

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0000 *20
0001 /PROGRAM LOG1024 / LOG SUBROUTINE
0002 /LOG4SCAL MODIFIED TO LOG1024
0003 /9-24-70
0004 /MODIFIED FROM LINC-8 TO PDP-12
0005 /7-27-70
0006 /PROGRAM LOG4SCAL
0007 /SET NEG TO BOTTOM OF SCAL
0010 /CALCULATE LOG OF SMOOTHED DATA AND SCALE FOR DISPLAY
0011 /11 13 68
0012 LMB=0600
0013 UMB=0640
0014 *1000
0015 1000 0011 CLR
0016 1001 2000 ADD 0
0017 1002 5160 STC E1+1
0020 1003 7041 JMP SR6 /FULL 1024 PTS
0021 1004 0647 LDF 7
0022 1005 1000 LDA
0023 1006 6034 POINTS
0024 1007 0017 COM
0025 1010 1460 SAE I
0026 1011 7377 -400
0027 1012 0456 SKP
0030 1013 7025 JMP SR4
0031 1014 1460 SAE I
0032 1015 6777 -1000
0033 1016 0456 SKP
0034 1017 7033 JMP SR5
0035 1020 1460 SAE I
0036 1021 5777 -2000
0037 1022 0456 SKP
0040 1023 7041 JMP SR6
0041 1024 0000 HLT
0042 1025 1040 SR4, STA
0043 1026 1071 NUM
0044 1027 5114 STC PTR2
0045 1030 0644 LDF 4
0046 1031 7061 JMP CALC2
0047 1032 7157 JMP E1 /MAIN EXIT
0050 1033 1040 SR5, STA
0051 1034 1071 NUM
0052 1035 5114 STC PTR2
0053 1036 0644 LDF 4
0054 1037 7061 JMP CALC2
0055 1040 7157 JMP E1
0056 1041 1020 SR6, LDA I
0057 1042 6777 -1000
0060 1043 1040 STA
0061 1044 1071 NUM
0062 1045 5114 STC PTR2
0063 1046 0644 LDF 4
0064 1047 7061 JMP CALC2
0065 1050 1020 LDA I
0066 1051 6777 -1000
0067 1052 1040 STA
0070 1053 1071 NUM
0071 1054 5114 STC PTR2
0072 1055 0645 LDF 5
0073 1056 7061 JMP CALC2
0074 1057 0644 LDF 4
-
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0075 1060 7157      JMP E1
0076          ///////////////
0077 1061 0011  CALC2, CLR
0100 1062 2000      ADD 0
0101 1063 5156      STC EXIT2
0102 1064 0065      SET I 5
0103 1065 7777      7777           /ADRS OF DATA
0104 1066 0066      SET I 6
0105 1067 7777      7777 /ANSR START AT 6000
0106 1070 0067      SET I 7
0107 1071 0000  NUM, 0           /MINUS NO.PTS
0110 1072 1025  J1,  LDA I 5
0111 1073 5310      STC L2
0112 1074 1025      LDA I 5
0113 1075 5311      STC L2+1
0114 1076 1000      LDA
0115 1077 1310      L2
0116 1100 0451      APO
0117 1101 7350      JMP X1 /SET TO ZERO IF NEG.
0120 1102 7166      JMP L1 /CALC LOG
0121 1103 1000      LDA
0122 1104 1312      L3
0123 1105 1066      STA I 6 /RETURN ANSR
0124 1106 1000      LDA
0125 1107 1313      L3+1
0126 1110 1066      STA I 6
0127 1111 0227      XSA I 7
0130 1112 7072      JMP J1
0131          /SCALE FOR DISPLAY
0132          /SCALING RTN
0133 1113 0066  H2,  SET I 6
0134 1114 0000  PTR2, 0
0135 1115 0072      SET I 12
0136 1116 3777  G6,  3777
0137 1117 1032      LDA I 12
0140 1120 5337      STC T1
0141 1121 1020      LDA I
0142 1122 0344      SCR 4
0143 1123 5132      STC J2
0144 1124 1032      LDA I 12
0145 1125 0017      COM
0146 1126 1140      ADM
0147 1127 1132      J2
0150 1130 1000      LDA
0151 1131 1337      T1
0152 1132 0344  J2,  SCR 4/SET EXPONENT4
0153 1133 3161      ADD G4
0154 1134 1052      STA 12
0155 1135 3144      ADD H4+1
0156 1136 0451      APO
0157 1137 7147      JMP H3/SET TO -377
0160 1140 3153      ADD J3
0161 1141 0451      APO
0162 1142 7154      JMP H1
0163 1143 1020  H4,  LDA I
0164 1144 0377      377
0165 1145 1052      STA 12
0166 1146 7154      JMP H1
0167 1147 1020  H3,  LDA I
0170 1150 7400      -377
0171 1151 1052      STA 12
0172 1152 7154      JMP H1
0173 1153 7000  J3,  -777
-
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0174      1154  0226  H1,      XSK  I  6
0175      1155  7117          JMP  G6+1
0176      1156  0016  EXIT2,   NOP
0177      1157  0602  E1,      LIF 2
                                         /EXIT WITH LOG OF NUM
                                         SCALED
0200      1160  0016          NOP
                                         /EXIT STORED HERE
0201
                                         /GO TO DISPLAY
0202
                                         /CONST TO SET
0203
                                         /LOWER SCALE
0204      1161  7200  G4,    -577
0205      1162  0000  V4,    0
0206      1163  0000          0
0207      1164  0000  V5,    0
0210      1165  0000          0
                                         /ENTER WITH
0211
                                         /NO. IN 2L
0213
                                         /EXIT WITH
0214
                                         /LOG IN 3L
0215      1166  0057  L1,    SET  17
0216      1167  0000          0
0217      1170  1000          LDA
0220      1171  1310          L2
0221      1172  0470          AZE  I
0222      1173  7270          JMP  Z6
0223      1174  0261          ROL  I  1
0224      1175  1560          BCL  I
0225      1176  4000          4000
0226      1177  5343          STC  T3
0227      1200  0063          SET  I  3
0230      1201  1337          T1
0231      1202  1020          LDA  I
0232      1203  7776          -1
0233      1204  3311          ADD  L2+1
0234      1205  7730          JMP  1730
0235      1206  7671          JMP  1671
0236      1207  1337          T1
0237      1210  1274          C1
0240      1211  1341          T2
0241      1212  5344          STC  T3+1
0242      1213  7671          JMP  1671
0243      1214  1343          T3
0244      1215  1343          T3
0245      1216  1326          Z2
0246      1217  7671          JMP  1671
0247      1220  1326          Z2
0250      1221  1326          Z2
0251      1222  1324          Z1
0252      1223  7671          JMP  1671
0253      1224  1324          Z1
0254      1225  1344          C5
0255      1226  1346          T4
0256      1227  7671          J.MP  1671
0257      1230  1343          T3
0260      1231  1326          Z2
0261      1232  1330          Z3
0262      1233  7671          J.MP  1671
0263      1234  1330          Z3
0264      1235  1302          C4
0265      1236  1337          T1
0266      1237  7437          JMP  1437
0267      1240  1337          T1
0270      1241  1346          T4
0271      1242  1346          T4

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0272	1243	7671	JMP	1671
0273	1244	1326	Z2	
0274	1245	1300	C3	
0275	1246	1337	T1	
0276	1247	7437	JMP	1437
0277	1250	1346	T4	
0300	1251	1337	T1	
0301	1252	1346	T4	
0302	1253	7671	JMP	1671
0303	1254	1343	T3	
0304	1255	1276	C2	
0305	1256	1337	T1	
0306	1257	7446	JMP	1446
0307	1260	1346	T4	
0310	1261	1337	T1	
0311	1262	1346	T4	
0312	1263	7446	JMP	1446
0313	1264	1346	T4	
0314	1265	1341	T2	
0315	1266	1312	L3	
0316	1267	6017	JMP	17
0317	1270	0011	Z6,	CLR
0320	1271	5312	STC	L3
0321	1272	5313	STC	L3+1
0322	1273	6017	JMP	17
0323			/CONST.	USED
0324			/IN	SERIES
0325			/EXPANSION	
0326	1274	2321	C1,	2321
0327	1275	7776		7776
0330	1276	3367	C2,	3367
0331	1277	7776		7776
0332	1300	3216	C3,	3216
0333	1301	7775		7775
0334	1302	3107	C4,	3107
0335	1303	7774		7774
0336	1304	3210	C5,	3210
0337	1305	7772		7772
0340	1306	0000	E4,	0
0341	1307	0000		0
0342	1310	0000	L2,	0
0343	1311	0000		0
0344	1312	0000	L3,	0
0345	1313	0000		0
0346	1314	0000	T7,	0
0347	1315	0000		0
0350	1316	0000	V1,	0
0351	1317	0000		0
0352	1320	0000	V2,	0
0353	1321	0000		0
0354	1322	0000	V3,	0
0355	1323	0000		0
0356	1324	0000	Z1,	0
0357	1325	0000		0
0360	1326	0000	Z2,	0
0361	1327	0000		0
0362	1330	0000	Z3,	0
0363	1331	0000		0
0364	1332	0000		0
0365	1333	0000	S4,	0000
0366	1334	0000		0
0367	1335	0000	S5,	0
0370	1336	0000		0

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0371      1337  0000  T1,    0
0372      1340  0000          0
0373      1341  0000  T2,    0
0374      1342  0000          0
0375      1343  0000  T3,    0
0376      1344  0000          0
0377      1345  7773  G3,   -4
0400      1346  0000  T4,    0
0401      1347  0000          0
0402      1350  0011  X1,    CLR
0403      1351  2000          ADD  0/SET EXIT
0404      1352  5355          STC   X2
0405      1353  5310          STC   L2/SET LOG EQUAL ZERO
0406      1354  5311          STC   L2+1
0407      1355  0000  X2,    0 /EXIT
0410
0411          POINTS=6034
0412          /CHANGE FULL 1024 PTS LN 16

```

NO ERRORS

CALC2	5061
C1	5274
C2	5276
C3	5300
C4	5302
C5	5304
EXIT2	5156
E1	5157
E4	5306
G3	5345
C4	5161
C6	5116
H1	5154
H2	5113
H3	5147
-4	5143
J1	5072
J2	5132
J3	5153
L1B	0600
L1	5166
L2	5310
L3	5312
NIM	5071
POINTS	6034
PTR2	5114
SR4	5425
SR5	5433
SR6	5041
S4	5333
S5	5335
T1	5337
T2	5341
T3	5343
T4	5346
T7	5314
T10	5649
V1	5315
V2	5323
V3	5322
V4	5162

Y5	5164
X1	5351
X2	5355
Z1	5324
Z2	5326
Z3	5330
Z6	5270

```

0000      *20
0001      /PROGRAM DIS FOCA. A DISPLAY PROGRAM
0002      /FOR DIFFERENT SPECTRA
0003      /9 24 70
0004      /FOR INTEREM. WRITTEN FOR LINC-8 AND
0005      /MODIFIED FOR PDP-12.7-31-70
0006      LMB=0600
0007      UMB=0640
0010      /DISPLAY DATA
0011      /1 4 69
0012      /TAKES TWO QUARTERS
0013      *20
0014      0020 0011      CLR
0015      0021 2000      ADD 0
0016      0022 4467      STC E1+2
0017      0023 0016      Q1,    NOP
0020      /DIS VERT
0021      0024 0070      SET I 10
0022      0025 7762      -15      /DISPLAY MARKER EVERY
                           20PTS
0023      0026 0071      SET I 11
0024      0027 0000      0
0025      0030 0072      F1,    SET I 12
0026      0031 7772      -5
0027      0032 1020      LDA I
0030      0033 7400      -377
0031      0034 0151      DIS 11
0032      0035 1100      ADA
0033      0036 0264      Q4
0034      0037 0232      XSK I 12
0035      0040 6034      JMP -4
0036      0041 1020      LDA I
0037      0042 0050      50
0040      0043 1140      ADM
0041      0044 0011      11
0042      0045 0230      XSK I 10
0043      0046 6030      JMP F1
0044      /CK LNCALL
0045      0047 6470      JMP A6
0046      /CHK SNS 5
0047      0050 0465      SNS I 5
0050      0051 6465      JMP E1
0051      /EXIT ON SNS 5
0052      /DISPLAT DATA 256 POINTS
0053      /DETERMINED BY SENSE SW
0054      0052 0461      SNS I 1
0055      0053 6063      JMP SR1
0056      0054 0462      SNS I 2
0057      0055 6073      JMP SR2
0060      0056 0463      SNS I 3
0061      0057 6103      JMP SR3
0062      0060 0464      SNS I 4
0063      0061 6113      JMP SR4
0064      0062 6144      JMP CONTIN
0065      //////
0066      0063 1000      SR1,    LDA
0067      0064 0000      0
0070      0065 4143      STC EXITD
0071      0066 0644      LDF 4      /DATA HERE
0072      0067 1020      LDA I
0073      0070 3777      3777      /1 TO 256
0074      0071 4131      STC QN
-
```

0075	0072	6123	JMP DISP	
0076	0073	1000	SR2,	LDA
0077	0074	0000	0	
0100	0075	4143	STC EXITD	
0101	0076	0644	LDF 4	
0102	0077	1020	LDA I	
0103	0100	2777	2777	
0104	0101	4131	STC QN	
0105	0102	6123	JMP DISP	
0106	0103	1000	SR3,	LDA
0107	0104	0000	0	
0110	0105	4143	STC EXITD	
0111	0106	0645	LDF 5	
0112	0107	1020	LDA I	
0113	0110	3777	3777	
0114	0111	4131	STC QN	
0115	0112	6123	JMP DISP	
0116	0113	1000	SR4,	LDA
0117	0114	0000	0	
0120	0115	4143	STC EXITD	
0121	0116	0645	LDF 5	
0122	0117	1020	LDA I	
0123	0120	2777	2777	
0124	0121	4131	STC QN	
0125	0122	6123	JMP DISP	
0126	0123	0016	DISP,	NOP
0127	0124	0071	Q2,	SET I 11
0130	0125	0776	776	
0131	0126	0073	SET I 13	
0132	0127	7377	-400/-144	
0133	0130	0072	SET I 12	
0134	0131	0000	QN,	0
0135	0132	0171	Q5,	DIS I 11
0136	0133	1020	LDA I	
0137	0134	0001	1	
0140	0135	1140	ADM	
0141	0136	0011	11	
0142	0137	0232	Q3,	XSK I 12
0143	0140	1032	LDA I 12	
0144	0141	0233	XSK I 13	
0145	0142	6132	JMP Q5	
0146	0143	0016	EXITD,	NOP
0147	0144	0016	CONTIN,	NOP
0150	0145	0647	LDF 7	
0151	0146	1000	LDA	
0152	0147	6173	6173	
0153	0150	4410	STC Q7	
0154	0151	1000	LDA	
0155	0152	0200	200	
0156	0153	0004	ESF	
0157	0154	0011	CLR	
0160	0155	1020	LDA I	
0161	0156	0410	Q7	
0162	0157	6312	JMP V1 /CV LN TO BCD	
0163	0160	6232	JMP X6 /DIS LN	
0164			/DISPLAY DATE	
0165	0161	0647	LDF 7	
0166	0162	0061	SET I 1	
0167	0163	0650	0650	
0170	0164	0067	SET I 7	
0171	0165	6000	6000	
0172	0166	0062	SET I 2	
0173	0167	7775	-2	

0174	0170	1327	J2,	LDH I 7
0175	0171	1560		BCL I
0176	0172	7760		7760
0177	0173	0241		ROL 1
0200	0174	1120		ADA I
0201	0175	0266		A1
0202	0176	4003		STC 3
0203	0177	1020		LDA I
0204	0200	0320		320
0205	0201	1743		DSC 3
0206	0202	1763		DSC I 3
0207	0203	0222		XSK I 2
0210	0204	6170		JMP J2
0211	0205	1020		LDA I
0212	0206	0010		10
0213	0207	1140		ADM
0214	0210	0001		1
0215	0211	0062		SET I 2
0216	0212	7775		-2
0217	0213	1327		LDH I 7
0220	0214	1327	J3,	LDH I 7
0221	0215	1560		BCL I
0222	0216	7760		7760
0223	0217	0241		ROL 1
0224	0220	1120		ADA I
0225	0221	0266		A1
0226	0222	4003		STC 3
0227	0223	1020		LDA I
0230	0224	0320		320
0231	0225	1743		DSC 3
0232	0226	1763		DSC I 3
0233	0227	0222		XSK I 2
0234	0230	6214		JMP J3
0235	0231	6023		JMP Q1
0236				/DISPLAY LN
0237	0232	0044	X6,	SET 4
0240	0233	0000		0
0241	0234	0061		SET I 1
0242	0235	0650		0650
0243	0236	0066		SET I 6
0244	0237	7774		-3
0245	0240	0067		SET I 7
0246	0241	0460		L1 /LN STORED HERE
0247	0242	1027	X5,	LDA I 7
0250	0243	1560		BCL I
0251	0244	7760		7760
0252	0245	0241		ROL 1
0253	0246	1120		ADA I
0254	0247	0266		A1
0255	0250	4003		STC 3
0256	0251	0104		SAM 4
0257	0252	1743		DSC 3
0260	0253	1763		DSC I 3
0261	0254	1020		LDA I
0262	0255	0004		4
0263	0256	1140		ADM
0264	0257	0001		1
0265	0260	0226		XSK I 6
0266	0261	6242		JMP X5
0267	0262	6004		JMP 4
0270	0263	6023		JMP Q1
0271	0264	0177	Q4,	177 /INDEX FOR H LINR
0272	0265	0000	Q6,	0

0273	0266	4136	A1,	4136
0274	0267	3641		3641
0275	0270	2101		2101
0276	0271	0177		0177
0277	0272	4523		4523
0300	0273	2151		2151
0301	0274	4122		4122
0302	0275	2651		2651
0303	0276	2414		2414
0304	0277	0477		0477
0305	0300	5172		5172
0306	0301	0651		0651
0307	0302	1506		1506
0310	0303	4225		4225
0311	0304	4443		4443
0312	0305	6050		6050
0313	0306	5126		5126
0314	0307	2651		2651
0315	0310	5120		5120
0316	0311	3651		3651
0317			/SUB TO GO BINARY TO BCD\	
0320			/ANSR IN 1L AND NEXT THREE BINS	
0321			/8 1 68	
0322			/ENTER WITH ADDRES OF NO. TO BE CV IN ACCUMULATOR	
0323			/BINARY TO DECIMAL	
0324	0312	4320	V1,	STC .+6
0325	0313	2000		ADD 0
0326	0314	4406		STC V3
0327	0315	0071		SET I 11
0330	0316	0457		L1-1
0331	0317	1020		LDA I
0332	0320	0000		0 /VAL. INSERTED BY PROGRAM
0333	0321	1040		STA
0334	0322	0424		S4
0335	0323	1040		STA
0336	0324	0420		S3
0337	0325	1000		LDA
0340	0326	0457		Y4+2
0341	0327	1040		STA
0342	0330	0437		S5
0343	0331	0017		COM
0344	0332	4422		STC S4-2
0345	0333	6411		JMP V2
0346	0334	1000		LDA
0347	0335	0452		Y1
0350	0336	1071		STA I 9
0351	0337	1020		LDA I
0352	0340	0454		Y3
0353	0341	1040		STA
0354	0342	0424		S4
0355	0343	1040		STA
0356	0344	0420		S3
0357	0345	1000		LDA
0360	0346	0456		Y4+1
0361	0347	1040		STA
0362	0350	0437		S5
0363	0351	0017		COM
0364	0352	4422		STC S4-2
0365	0353	6411		JMP V2
0366	0354	1000		LDA
0367	0355	0452		Y1
0370	0356	1071		STA I 9
0371	0357	1020		LDA I

0372	0360	0454	Y3
0373	0361	1040	STA
0374	0362	0424	S4
0375	0363	1040	STA
0376	0364	0420	S3
0377	0365	1000	LDA
0400	0366	0455	Y4
0401	0367	1040	STA
0402	0370	0437	S5
0403	0371	0017	COM
0404	0372	4422	STC S4-2
0405	0373	6411	JMP V2
0406	0374	1000	LDA
0407	0375	0452	Y1
0410	0376	1071	STA I 9
0411	0377	1000	LDA
0412	0400	0454	Y3
0413	0401	1460	SAE I
0414	0402	7777	7777
0415	0403	0456	SKP
0416	0404	0017	COM /TAKECARE OF MINUS ZERO
0417	0405	1071	STA I 9
0420	0406	0000	V3, 0 /EXIT
0421	0407	0000	0000 /EXIT
0422	0410	0000	Q7, 0 /TEMP STORE
0423			/OCTALL NO. TO HOW MANY X,S
0424	0411	0011	V2, CLR
0425	0412	4452	STC Y1
0426	0413	2000	ADD 0
0427	0414	4451	STC V4
0430	0415	0011	CLR
0431	0416	4452	STC Y1
0432	0417	1000	LDA
0433	0420	0000	S3, 0 /ADDRS OCTAL NO.
0434	0421	1120	ADA I
0435	0422	0000	0 /FACTOR -X
0436	0423	1040	STA
0437	0424	0000	S4, 0 /ADDRS OCTAL NO.
0440	0425	0451	APO
0441	0426	6434	JMP .+6
0442	0427	1020	LDA I
0443	0430	0001	1
0444	0431	1140	ADM
0445	0432	0452	Y1
0446	0433	6417	JMP V2+6
0447	0434	0470	AZE I
0450	0435	6441	JMP .+4
0451	0436	1120	ADA I
0452	0437	0000	S5, 0 /FACTOR X
0453	0440	6446	JMP .+6
0454	0441	1020	LDA I
0455	0442	0001	1
0456	0443	1140	ADM
0457	0444	0452	Y1
0460	0445	0011	CLR
0461	0446	4453	STC Y2
0462	0447	2453	ADD Y2
0463	0450	4454	STC Y3 /3Y CONTAINS LEFTOVER NO.
0464	0451	0000	V4, 0 /EXIT
0465	0452	0000	Y1, 0
0466	0453	0000	Y2, 0
0467	0454	0000	Y3, 0
0474	0455	0012	Y4, 12

0471	0456	0144	144
0472	0457	1750	1750 /FACTORS TO GET DECIMAL
0473	0460	0000	L1, ITS 00/ THESE FOR SPACES TEMP STORAGE OF DIG
0474	0461	0000	00
0475	0462	0000	00
0476	0463	0000	00
0477	0464	0000	00
0500	0465	0602	E1, 0602/CHANGE MEMORY BANK
0501	0466	0016	NOP /SPACE TO CHANGE UMB IF NEEDED
0502	0467	0016	NOP /SPACE FOR RETURN
0503	0470	0642	A6, LDF 2
0504	0471	1000	LDA
0505	0472	2376	2376 /LNCALL
0506	0473	0644	LDF 4 /DATA HERE FOR FOCAL /THIS LOCATION MUST BE CHANGED IF DATA CHANGED
0507			
0510	0474	0470	AZE I
0511	0475	6000	JMP 0
0512	0476	6465	JMP E1 /LNCALL SET RETURN TO CONTROL

NO ERRORS

A1	4266
A6	4470
CONTIN	4144
DISP	4123
EXITD	4143
E1	4465
F1	4030
J2	4170
J3	4214
LMB	0600
L1	4460
QN	4131
Q1	4023
Q2	4124
Q3	4137
Q4	4264
Q5	4132
Q6	4265
Q7	4410
SR1	4063
SR2	4073
SR3	4103
SR4	4113
S3	4420
S4	4424
S5	4437
UMB	0640
V1	4312
V2	4411
V3	4406
V4	4451
X5	4242
X6	4232
Y1	4452
Y2	4453
Y3	4454
Y4	4455



## APPENDIX 2



PROGRAM OLDDATA

```

0000      *20
0001      ///////////////PROGRAM OLDDATA/////////////
0002      /THIS PROGRAM RECALLS DATA STORED ON
0003      /TAPE BY PROGRAM INTEREM CONTROL.
0004      /10-16-70
0005          PMODE
0006          *2240
0007      2240  7000      NOP
0010      2241  6221      CDF+20
0011      2242  6222      CIF+20
0012      2243  5644      JMP I STARTF
0013      2244  7610      STARTF, 7610
0014      2245  7000      NOP
0015      2246  5640      JMP I +-6
0016          LMODE
0017          SEGMENT 2
0020          *20
0021
0022          /INTEREM1
0023          SEGMENT 2
0024          *20
0025      0020  0700      RDC
0026      0021  2247      2247
0027      0022  0700      RDC
0030      0023  3250      3250
0031      0024  0643      LDF 3           /ANSWR TO GO IN FIELD
0
0032      0025  7000      JMP QAINIT
0033      0026  0032      TEST
0034      0027  0351      ANSR
0035      0030  7053      JMP QARFSH
0036          /GET CONDITIONS TO BE PUT HERE
0037      0031  6064      JMP LOAD
0040          TEST, TEXT Z
0041      0032  4043
0041      0033  4711
0041      0034  1624
0041      0035  0522
0041      0036  0515
0041      0037  4003
0041      0040  1716
0041      0041  2422
0041          INTEREM CONTROL
0042      0042  1714
0042      0043  4320
0042      0044  1405
0042      0045  0123
0042      0046  0540
0042      0047  2431
0042      0050  2005
0042      0051  4024
0042      0052  1005
0042      0053  4022
0042      0054  2516
0042      0055  4016
0042      0056  2515
0042      0057  0205
0042      0060  2256
0042      0061  7462
0042      0062  7461
0042      0063  3400
0042          PLEASE TYPE THE RUN NUMBER.<2<1\Z

```

```

0043      /ANSWR TO GO IN FIELD 0
0044          QAINIT=1000
0045          QARFSH=1053
0046  0064  0016  LOAD, NOP           /LOAD REST OF SYS
0047          /PROGRAM RDC FOCA MODIFIED FROM LINC-8
0050          /FORMAT TO PDP-12 FORMAT. 7-31-70
0051          ZTA=5
0052          LMB=0600
0053          UMB=0640
0054      0065  1020    LDA I
0055      0066  0700    RDC           /NOT INST
0056      0067  4335    STC DO      /TELL IT TO READ
0057      0070  1020    LDA I
0060      0071  3224    3224
0061      0072  4336    STC X2
0062      0073  0650    UMB 10
0063      0074  6324    JMP X1
0064      0075  1020    LDA I
0065      0076  3230    3230
0066      0077  4336    STC X2
0067      0100  0651    UMB 11
0070      0101  6324    JMP X1
0071      0102  1020    LDA I
0072      0103  3234    3234
0073      0104  4336    STC X2
0074      0105  0652    UMB 12
0075      0106  6324    JMP X1
0076      0107  1020    LDA I
0077      0110  3240    3240
0100      0111  4336    STC X2
0101      0112  0653    UMB 13
0102      0113  6324    JMP X1
0103          ////END RDC FOCA
0104          ///LOAD DATA 256 FROM TAPE
0105      0114  0654    LDF 14
0106      0115  0700    RDC
0107      0116  5263    5263
0110          ///END DATA256
0111          ///LOAD LOG4SCALE
0112      0117  0700    RDC
0113      0120  6265    6265
0114          ///END L4S
0115          ///LOAD SPFLT
0116      0121  0700    RDC
0117      0122  7267    7267
0120          ///END SPFLT
0121          ///LOAD DIS FOCA PART 1
0122      0123  0655    LDF 15
0123      0124  0700    RDC
0124      0125  4252    4252
0125          ///LOAD DIS FOCA PART 2
0126      0126  0700    RDC
0127      0127  5253    5253
0130          ///END DIS FOCA
0131          ///LOAD THREE BLOCKS OF NEWPRINT FOR PRINTOUT
0132      0130  0700    RDC
0133      0131  1257    1257
0134      0132  0700    RDC
0135      0133  2260    2260
0136      0134  0700    RDC
0137      0135  3261    3261
0140      0136  0646    LDF 6      /LOAD FNEW CONST
0141      0137  0700    RDC
-
```

```

0142    0140  4270      4270
0143    0141  0700      RDC
0144    0142  5271      5271
0145    0143  0700      RDC
0146    0144  6272      6272
0147    0145  0700      RDC
0150    0146  7273      7273
0151    0147  0644      LDF 4
0152          /DATA STORAGE AREA
0153          CONDIT=400
0154          PRNTOU=1000
0155    0150  0016      NOP/FLOAT,     LIF 14
0156          /DATA ALREADY IN SPFLT
0157          /GO TO DATA EM
0160    0151  0016      NOP/      JMP 400
0161    0152  6214      JMP RDCDATA
0162    0153  0016      NOP/      JMP CONDIT   /PART OF PRNTOUT
0163          /USE CONDITIONS ON TAPE
0164          /PART OF NEWPRNT SOURCE
0165    0154  7000      JMP PRNTOU
0166    0155  6500      JMP CHANGE
0167          CHANGE=500
0170          /PART OF NEWPRNT SOURCE
0171          /REVERSE FOR FOCAL! INTERCHANGE
0172          /MANTISSE AND EXPONENT FOR FOCAL
0173    0156  0500      I0B
0174    0157  6002      6002      /I0F FOR FOCAL IN FIE
LD 2
0175    0160  6201      JMP FOCAL
0176    0161  6500      JMP CHANGE   /CHANGE BACK
0177          /FOR SPFLPT
0200          /GET LOG
0201    0162  0614      LIF 14
0202    0163  7000      JMP 1000
0203    0164  0500      I0B
0204    0165  6042      6042
0205    0166  0500      I0B
0206    0167  6001      6001      /CLR TTY AND ION
0207          /HIT THAT OLD DISPLAY
0210    0170  0615      LIF 15
0211    0171  6020      JMP 20
0212    0172  0016      NOP
0213    0173  6020      JMP 20   /FOR NEXT CURVE
0214    0174  0000      HLT   /FOR CHECK
0215          /GO ACROSS PAGE BOUNDARY
0216    0175  0000      HLT
0217    0176  0000      HLT
0220    0177  0000      HLT
0221    0200  0000      HLT
0222          /THE FOCAL EXIT CAN BE CHANGED
0223    0201  0011      FOCAL, CLR
0224    0202  2000      ADD 0
0225    0203  4212      STC EX1
0226    0204  0002      PDP
0227          PMODE
0230    4205  4613      JMS I FOCAGO
0231    4206  7000      NOP
0232    4207  6141      LINC
0233          LMODE
0234    0210  0644      LDF 4
0235    0211  0602      LIF 2   /RESET DATA FIELD AND
                           INST FOR CONTROL
0236    0212  0000      EX1,  0
-
```

0237	0213	2240	FOCAGO, 2240
0240			/PROGRAM TO READ DATA FROM TAPE.
0241			/PROGRAM READS ALL OF FIELD1 ON TAPE 1
0242	0214	1000	RDCDATA,LDA
0243	0215	0000	0
0244	0216	4315	STC EX2
0245	0217	1020	LDA I
0246	0220	0710	RDC U
0247	0221	4335	STC DO
0250	0222	1000	LDA
0251	0223	0351	ANSR
0252	0224	1560	BCL I
0253	0225	7760	7760
0254	0226	1240	MUL
0255	0227	0316	TEN
0256	0230	4317	STC TEMP
0257	0231	1000	LDA
0260	0232	0352	ANSR+1
0261	0233	0346	SCR 6
0262	0234	1560	BCL I
0263	0235	7760	7760
0264	0236	1140	ADM
0265	0237	0317	TEMP
0266	0240	2321	ADD M30
0267	0241	0471	APO I
0270	0242	0000	HLT
0271	0243	2322	/BN TOO BIG
0272	0244	0244	/RESTOR BN
0273	0245	4317	STC TEMP
0274	0246	1000	LDA
0275	0247	0353	ANSR+2
0276	0250	0346	SCR 6
0277	0251	1560	/MOVE NO OVER
0280	0252	7770	BCL I
0281	0253	2320	7770
0302	0254	0241	ADD M1
0303	0255	2317	ROL 1
0304	0256	1620	ADD TEMP
0305	0257	4000	/MUL BY TWO
0306	0260	1040	4000
0307	0261	0270	/DATA BLK TO BE READ
0310	0262	1120	STA
0311	0263	1001	ADA I
0312	0264	1040	1001
0313	0265	0272	STA
0314	0266	0644	DATA2
0315	0267	0710	0644
0316	0270	0000	LDF 4
0317	0271	0710	RDC U
0320	0272	0000	DATA1, 0
0321	0273	1000	RDC U
0322	0274	0317	0
0323	0275	1120	TEMP
0324	0276	0014	ADA I
0325	0277	1620	1120
0326	0300	4000	ADA I
0327	0301	1040	4000
0330	0302	0311	STA
0331	0303	1120	DATA3
0332	0304	1001	0311
0333	0305	1040	1001
0334	0306	0313	STA
0335	0307	0647	DATA4
			LDF 7
			/PUT CONDITION IN 7

```

0336    0310  0710      RDC U
0337    0311  0000  DATA3,  0
0340    0312  0710      RDC U
0341    0313  0000  DATA4,  0
0342    0314  0644      LDF 4
0343    ///////////////////
0344    //NO UPDATE
0345    0315  0000  EX2,   0
0346    0316  0012  TEN,   12      /FACTOR TEN
0347    0317  0000  TEMP,  0      /STORE CURVE NUM
0350    0320  7776  M1,   -1
0351    0321  7740  M30,  -37
0352    0322  0037  P30,   37
0353    0323  0000  ANSR2,  0      /NOT REALLY NEEDED
0354    0324  1000  X1,   LDA
0355    0325  0000      0
0356    0326  4350      STC X4
0357    0327  0065      SET I 5
0360    0330  7773      -4
0361    0331  1020  X3,   LDA I
0362    0332  1001      1001
0363    0333  1140      ADM
0364    0334  0336      X2
0365    0335  0016  DO,   NOP
0366    0336  0000  X2,   0
0367    0337  0225      XSK I 5
0370    0340  6331      JMP X3
0371    0341  1000      LDA
0372    0342  0336      X2
0373    0343  1560      BCL I
0374    0344  7000      7000
0375    0345  1620      BSE I
0376    0346  3000      3000
0377    0347  4336      STC X2
0400    0350  0000  X4,   0
0401    0351  0000  ANSR,  0
0402    0352  0000      0      /FOR QANDA
0403    0353  0000      0      /3 LOC FOR ANSR
0404          *376
0405    0376  0000  CALL,  0
0406
0407    0377  0000  RUNN1,  0
0410    ///////////////////
0411    //BE SURE A DATA TAPE IS ON UNIT 1

```

NO ERRORS

ANSR	4351
ANSR2	4323
CALL	4376
CHANGE	0500
CONDIT	0400
DATA1	4270
DATA2	4272
DATA3	4311
DATA4	4313
DO	4335
EX1	4212
EX2	4315
FOCAGO	4213
FOCAL	4201
LMB	0600
LOAD	4064

M1	4320
M30	4321
PRNTOU	1000
P30	4322
QAINIT	1000
QARFSH	1053
RDCDAT	4214
RUNNU	4377
STARTF	2244
TEMP	4317
TEN	4316
TEST	4032
UMB	0640
X1	4324
X2	4336
X3	4331
X4	4350
ZTA	0005

## APPENDIX 3



PROGRAM MODFOCA

```

0000 *20
0001 ///////////////PROGRAM MOD FOCA/////////
0002 //PROGRAM TO READ AND START FIELD 2 FOCAL
0003 //START 400 LMODE TO WRITE IT ON TAPE
0004 //9-3-70
0005 //PROGRAM RDC FOCA MODIFIED FROM LINC-8
0006 //FORMAT TO PDP-12 FORMAT. 7-31-70
0007 ZTA=5
0010 LMB=0600
0011 UMB=0640
0012 0020 0065 SET I 5
0013 0021 7773 -4
0014 0022 1020 LDA I
0015 0023 0700 RDC /NOT INST
0016 0024 4075 STC DO /TELL IT TO READ
0017 0025 1020 LDA I
0020 0026 3224 3224
0021 0027 4076 STC X2
0022 0030 0650 UMB 10
0023 0031 6066 JMP X1
0024 0032 1020 LDA I
0025 0033 3230 3230
0026 0034 4076 STC X2
0027 0035 0065 SET I 5
0030 0036 7773 -4
0031 0037 0651 UMB 11
0032 0040 6066 JMP X1
0033 0041 1020 LDA I
0034 0042 3234 3234
0035 0043 4076 STC X2
0036 0044 0065 SET I 5
0037 0045 7773 -4
0040 0046 0652 UMB 12
0041 0047 6066 JMP X1
0042 0050 1020 LDA I
0043 0051 3240 3240
0044 0052 4076 STC X2
0045 0053 0653 UMB 13
0046 0054 0065 SET I 5
0047 0055 7773 -4
0050 0056 6066 JMP X1
0051 0057 0643 UMB 3
0052 0060 0002 PDP
0053 PMODE
0054 4061 6221 CDF +20 /FIELD 2
0055 4062 6222 CIF +20 /FIELD 2
0056 4063 5664 JMP I START
0057 4064 0200 START, 200 /FOCAL START
0060 4065 7402 HLT
0061 LMODE
0062 0066 1000 X1, LDA
0063 0067 0000 0
0064 0070 4101 STC E1
0065 0071 1020 X3, LDA I
0066 0072 1001 1001
0067 0073 1140 ADM
0070 0074 0076 X2
0071 0075 0700 DO, RDC
0072 0076 7777 X2, 7777
0073 0077 0225 XSK I 5
0074 0100 6071 JMP X3
0075 0101 0000 E1, 0

```

```

0076
0077           //////////////WARNING THIS CHANGES FOCAL IN FIELD 2
0100           LMODE
0101           SEGMNT 2
0102           *400
0103           /PROGRAM RDC FOCA MODIFIED FROM LINC-8
0104           /FORMAT TO PDP-12 FORMAT. 7-31-70
0105           ZTA=5
0106           LMB=0600
0107           UMB=0640
0110           0400  0065      SET I 5
0111           0401  7773      -4
0112           0402  1020      LDA I
0113           0403  0704      WRC          /NOT INST
0114           0404  4075      STC DO       /TELL IT TO WRITE NE
0115           0405  1020      LDA I
0116           0406  3224      3224
0117           0407  4076      STC X2
0120           0410  0650      UMB 10
0121           0411  6066      JMP X1
0122           0412  1020      LDA I
0123           0413  3230      3230
0124           0414  4076      STC X2
0125           0415  0065      SET I 5
0126           0416  7773      -4
0127           0417  0651      UMB 11
0130           0420  6066      JMP X1
0131           0421  1020      LDA I
0132           0422  3234      3234
0133           0423  4076      STC X2
0134           0424  0065      SET I 5
0135           0425  7773      -4
0136           0426  0652      UMB 12
0137           0427  6066      JMP X1
0140           0430  1020      LDA I
0141           0431  3240      3240
0142           0432  4076      STC X2
0143           0433  0653      UMB 13
0144           0434  0065      SET I 5
0145           0435  7773      -4
0146           0436  6066      JMP X1
0147           0437  0643      UMB 3
0150           0440  0002      PDP
0151           0441  6221      PMODE
0152           0442  7402      CDF +20      /FIELD 2
0153           0442  7402      HLT
0154           //////////////WARNING THIS CHANGES FOCAL IN FIELD 2

```

NO ERRORS

DO	4075
Z1	4101
LMB	0600
START	4064
UMB	0640
X1	4066
X2	4076
X3	4071
ZTA	0005

```

0000      *20
0001      / FOR FOCALW IN FIELD 2 DATA IN FIELD 1
0002          PMODE
0003          /SUBROUTINE START AT 7600
0004          /FOCAL OVERLAY FOR S P FLOAT
0005          /DEFINITIONS
0006              INTEGER=53
0007              FLAC=44
0010              SPNOR=4560
0011              CETC=4545
0012              EVAL=1613
0013              CHAR=66
0014              PUSHJ=4540
0015              FIELD2=6221
0016              FIELD1=6211
0017              ERROR4=4566
0020              EFUN3I=136
0021              FNTAB=374
0022              PUSH4=4542
0023              POPA=1413
0024          //
0025          *63
0026      0063  1354      1354      /NO INTERRUPTS
0027      0064  2666      2556
0030          *2732
0031      2732  5336      5336
0032          *2762
0033      2762  7000      7000
0034          *1201
0035      1201  2725      2725      /NO HSR
0036          *FNTAB+14
0037      0410  7620      XFNEW
0040          *7600
0041          /EXIT TO FIELD ZERO
0042      7600  7000      NOP
0043      7601  6201      CDF 0
0044      7602  6202      CIF 0
0045      7603  5604      JMP I RETURN
0046      7604  7000      RETURN, NOP      /ENTER WITH JMS
0047      7605  7300      CLA CLL
0050      7606  1216      TAD K0777
0051      7607  3613      DCA I A3141
0052      7610  1215      TAD K1577
0053      7611  3614      DCA I A3142
0054      7612  5617      JMP I WHEE
0055      7613  3141      A3141,3141
0056      7614  3142      A3142,3142
0057      7615  1577      K1577,1577
0060      7616  0777      K0777,0777
0061      7617  0231      WHEE,231
0062      7620  4453      XFNEW,JMS I INTEGER/MAKE 12 BITS
0063      7621  1306      TAD M2451
0064      7622  7500      SMA
0065      7623  4566      ERROR4/JMS I 166
0066      7624  1307      TAD P2451
0067      7625  3311      DCA TEMP
0070      7626  1311      TAD TEMP
0071      7627  7104      RAL CLL
0072      7630  4542      PUSH4/JMS I 142
0073      7631  4550      SPNOR /JMS I 160
0074      7632  1066      TAD CHAR
0075      7633  1310      TAD MCOMMA

```

0076	7634	7640	SZA CLA
0077	7635	5262	JMP XFNEW3
0100	7636	4545	GETC/JMS I 145
0101	7637	4540	PUSHJ /JMS I 140
0102	7640	1613	EVAL
0103	7641	1413	POPA/TAD I 13
0104	7642	3305	DCA PTR
0105	7643	1044	TAD FLAC
0106	7644	6211	FIELD1
0107	7645	3705	DCA I PTR
0110	7646	6221	FIELD2
0111	7647	2305	ISZ PTR
0112	7650	1045	TAD FLAC+1
0113	7651	6211	FIELD1
0114	7652	3705	DCA I PTR
0115	7653	6221	FIELD2
0116	7654	4560	END,SPNOR
0117	7655	1066	TAD CHAR
0120	7656	1304	TAD RPAR
0121	7657	7640	SZA CLA
0122	7660	4566	ERROR4
0123	7661	5536	JMP I EFUN3I
0124	7662	1413	XFNEW3,POPA
0125	7663	3303	DCA PTR
0126	7664	6211	FIELD1
0127	7665	1703	TAD I PTR
0130	7666	6221	FIELD2
0131	7667	3044	DCA FLAC
0132	7670	2303	ISZ PTR
0133	7671	6211	FIELD1
0134	7672	1703	TAD I PTR
0135	7673	6221	FIELD2
0136	7674	3045	DCA FLAC+1
0137	7675	7000	NOP/ISZ PTR
0140	7676	7000	NOP/FIELD1
0141	7677	7000	NOP/TAD I PTR
0142	7700	7000	NOP/FIELD2
0143	7701	3046	DCA FLAC+2
0144	7702	5254	JMP END
0145	7703	0000	PTR,0
0146	7704	7527	RPAR,-251
0147	7705	4000	PTR,0
0150	7706	4104	M2451,-3674/FNR S P ONLY
0151	7707	3674	P2451,3674/FOR S P ONLY
0152	7710	7524	MCOMMA,-254
0153	7711	0000	TEMP,0
0154			LISTAPE-1

NO ERRORS

A3141	7613
A3142	7614
CHAR	0066
EFUN,I	0136
E,D	7654
ERROR4	4566
EVAL	1613
FIELD1	6211
FIELD2	6221
FLAC	0044
FNT4B	0374
GETC	4545
INTEG3	1053

0777	7616
A1577	7615
MCOMMA	7710
M2451	7704
PNTR	7705
POPA	1413
PTR	7703
PUSHA	4542
PUSHJ	4540
P2451	7707
RETURN	7604
RPAR	7704
SP1, R	4560
TEMP	7711
WHEE	7617
XFNEW	7620
XFNEW3	7662



## APPENDIX 4



INTERFACES

Input to the PDP-12 from the experimental equipment is by way of the built-in A-D converters and by interfaces made up of M-series logic modules from Digital Equipment Corporation.

Connections to the A-D converters are made across resistors of a value chosen to give either direct readings or some simple multiple thereof. For instruments with multiple scales, we have added the switching circuit shown in Fig. 4-1 to the range changing switch. The output goes to a Type M734 logic board which can input three 12 bit words. Since the simple switch takes only three bits, four switches can be connected to a single word. Decoding is by program CONTROL.

## WIRING SECTION

Figure 4-2 shows the connections on the DW08A I/O and data break bus of the PDP-12. This is the location to make cable connections to and from the various computer buses. The notation is that used by Digital Equipment for all its units.

Figure 4-3 shows a block diagram of the interface board (Dec Type H910) as set up for INTEREM. All interface wiring indicated in subsequent drawings follows PDP-12 notation, i.e. 6A12 would be Row A, Slot 6, Pin 12; 6B11 would be Row B, Slot 6, Pin 11. The logic modules M732 and M734 are double width boards and have connectors on both Row A and B. The M903 cables, M602, and M624 modules are single width units.

Figure 4-4 shows the typical connections to the M734 logic board used for the scale factors mentioned above. When the indicated I/O command is given by the program, the indicated word is strobed into a core memory location where it is available for decoding and use as necessary. The instruction 6361 produces IOT1 which strobos word A into the AC bus driver. Similarly, 6362 and 6364 strobe in words B and C.

The Hewlett-Packard pulse height analyzer is interfaced by means of a M732 logic module. The M732 and the M624 bus driver provide a complete positive logic input interface for the PDP-12. It can receive 12 parallel bits from the external device and transmit 12 bits to the

computer by BAC bus. It accepts device selector code from the MB bus and IOP pulses from the IOP bus to perform flag clearing, transmitting ready and start pulses to and from the HP analyzer and output strobe to the computer. The high speed serial punch output connections of the HP analyzer are utilized. Connections to this output are shown in Fig. 4-5. The connections to the M732 and M624 are shown in Figs. 4-6 and 4-7.

Unused TTL gates in M-series logic modules must be held high (+ 3 v). This is done with the  $M\phi 2$  Logic 1 source. Connections to the  $M\phi 2$  are shown in Figs. 4-8 - 4-10.

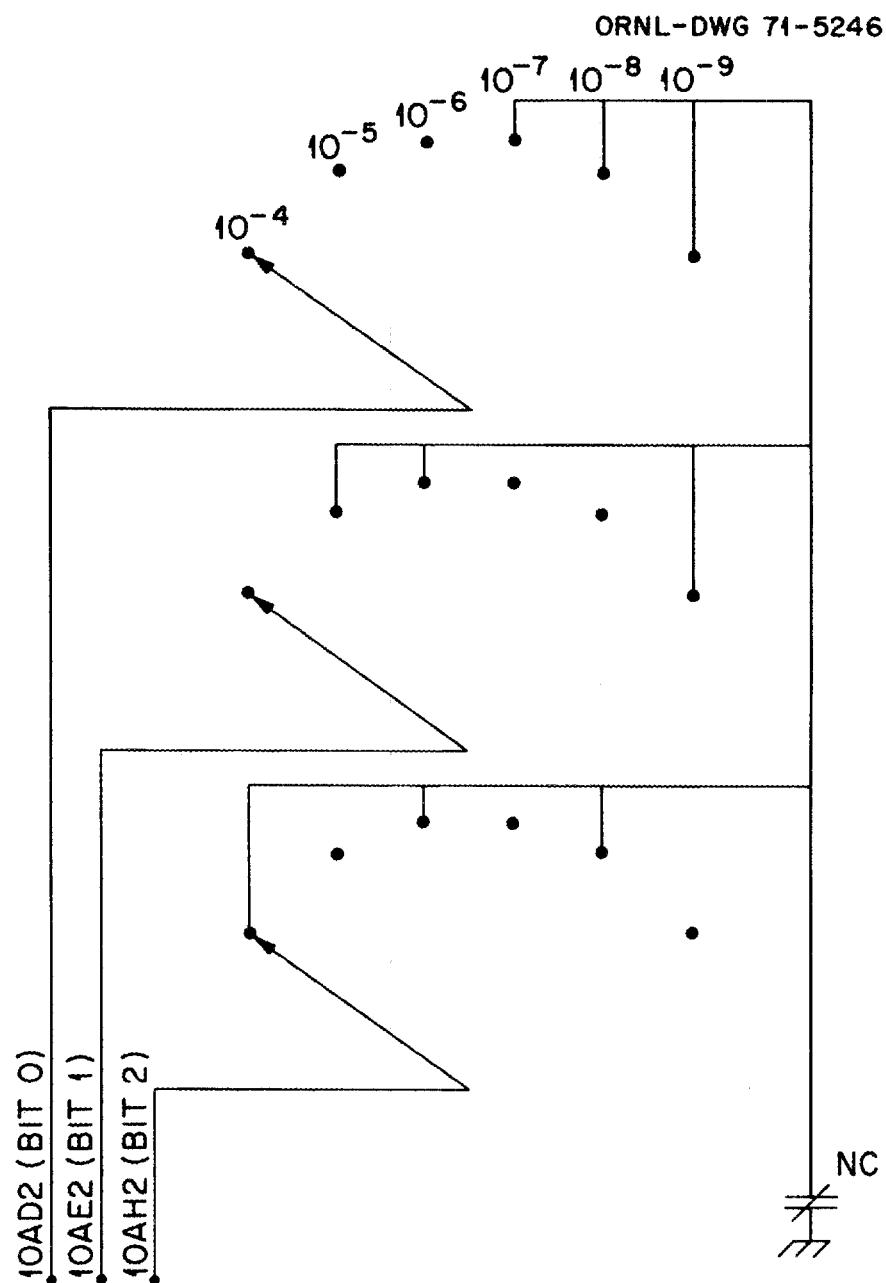


Fig. 4-1. Typical range change switching circuit for a pressure gage.

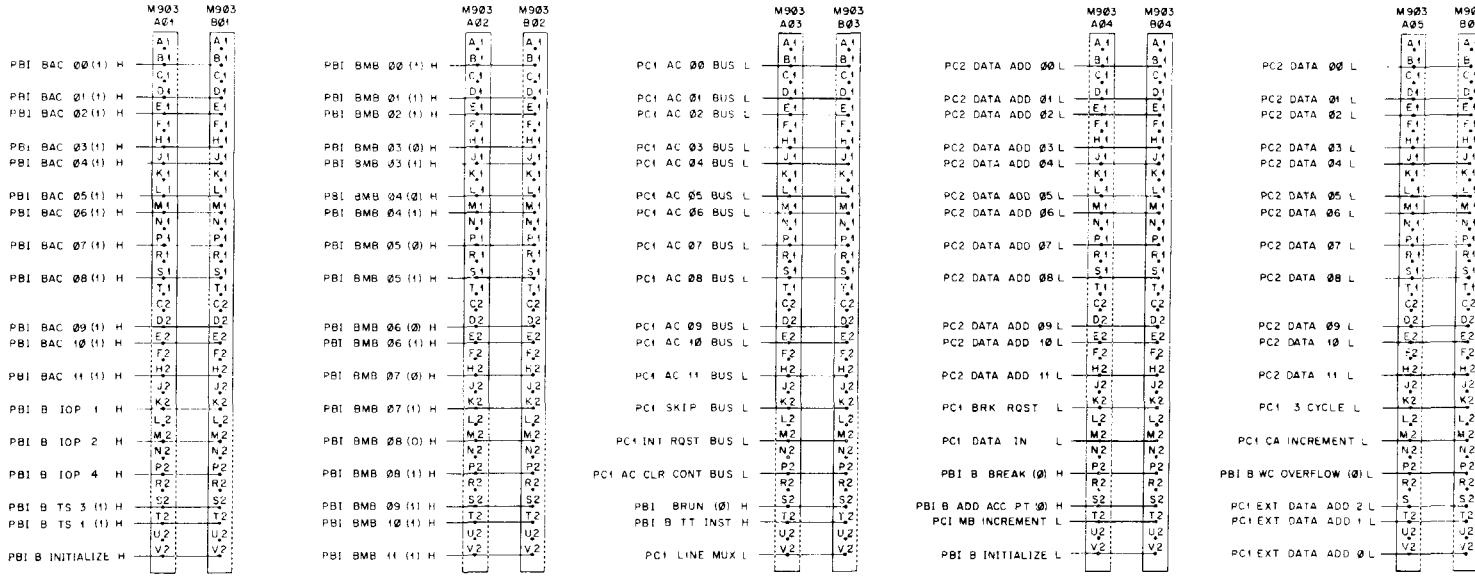


Fig. 4-2. DW<sub>08A</sub> connections.

ORNL-DWG 70-13243

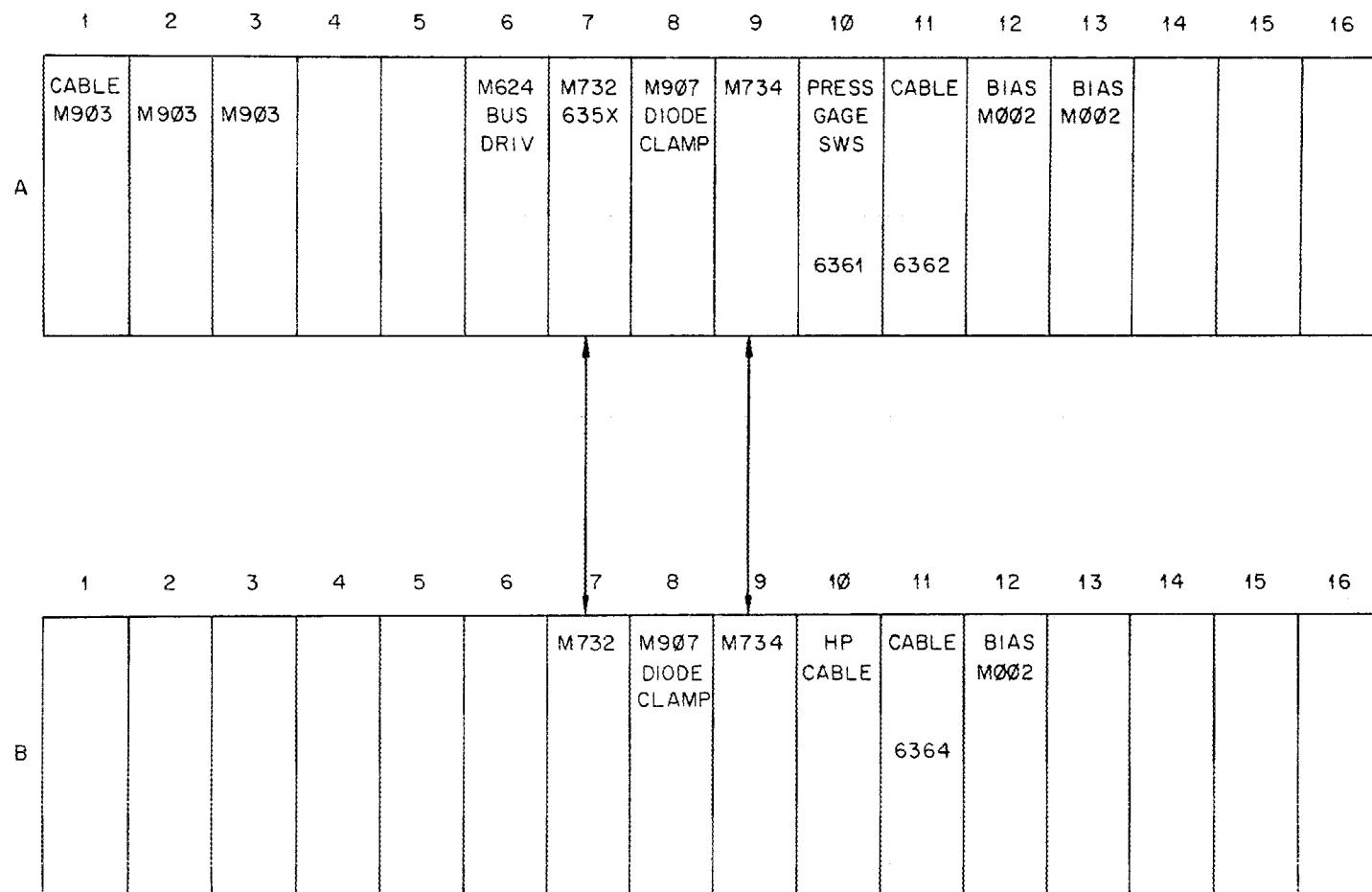


Fig. 4-3. Block diagram of interface board.

ORNL-DWG 70-13246

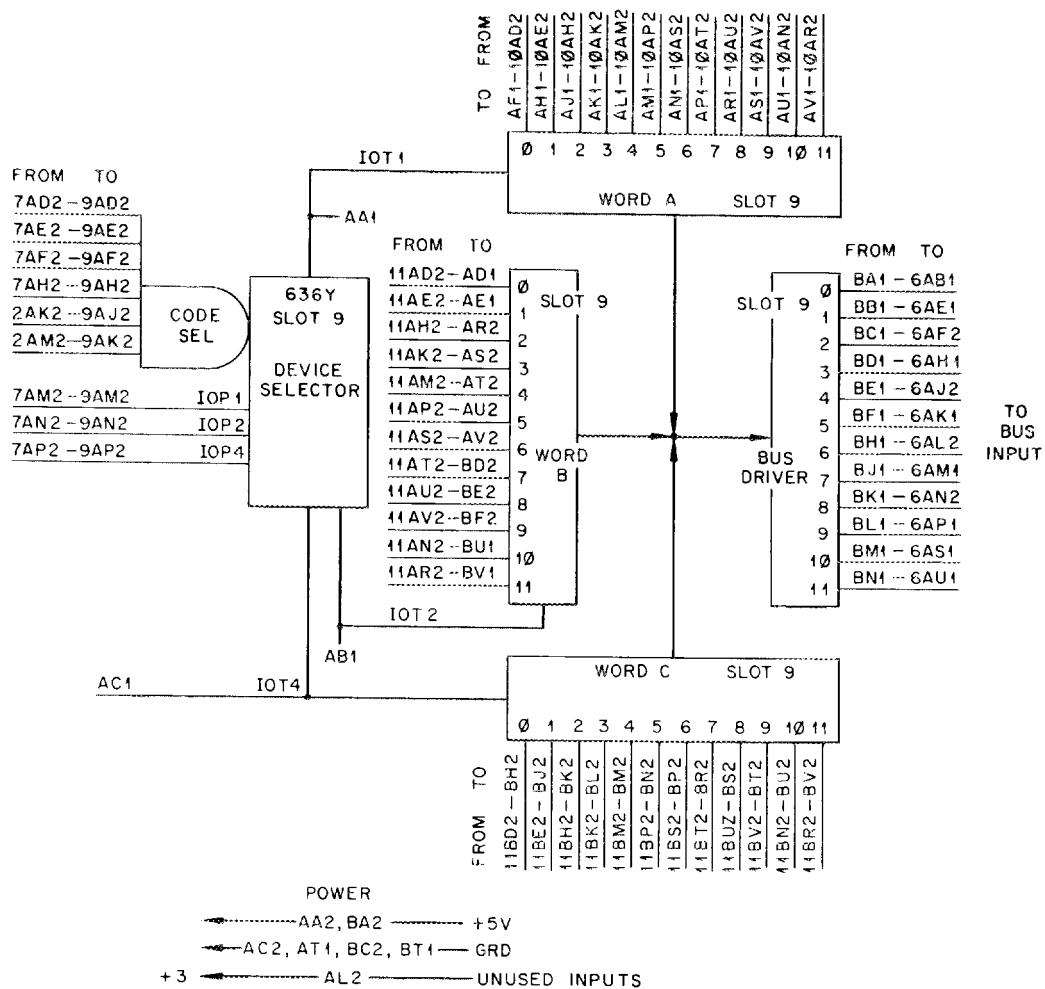


Fig. 4-4. Connections to M634 board.

ORNL-DWG 70-13240

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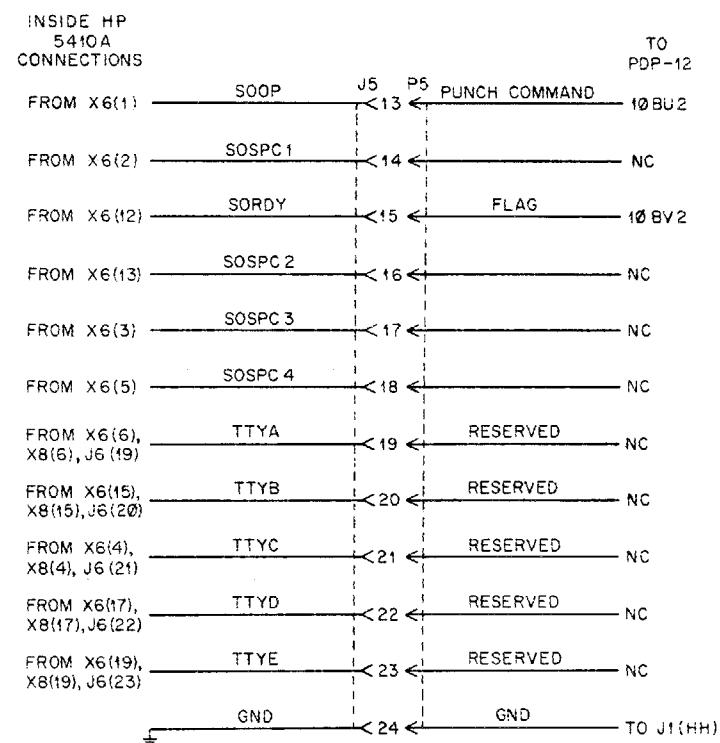
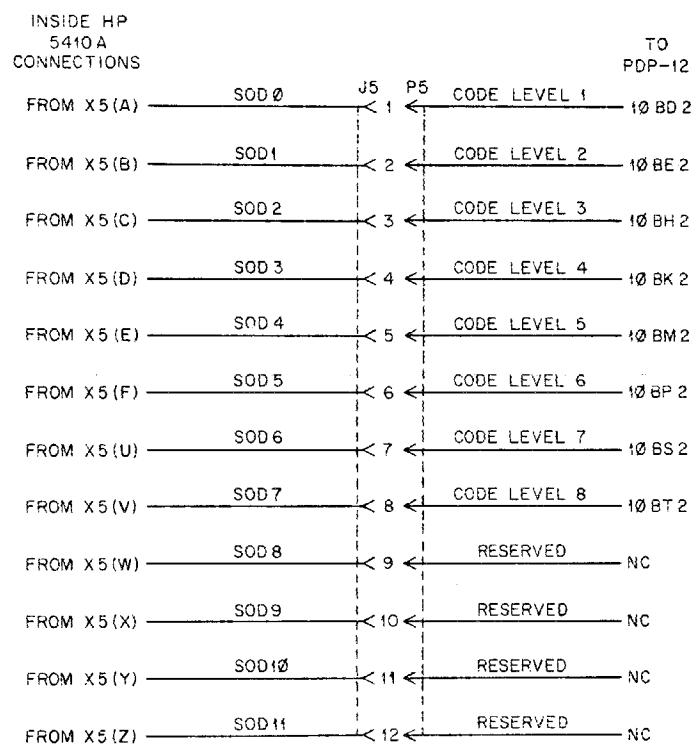


Fig. 4-5. Connections from HP 5401B multichannel analyzer.

ORNL-DWG 70-13244

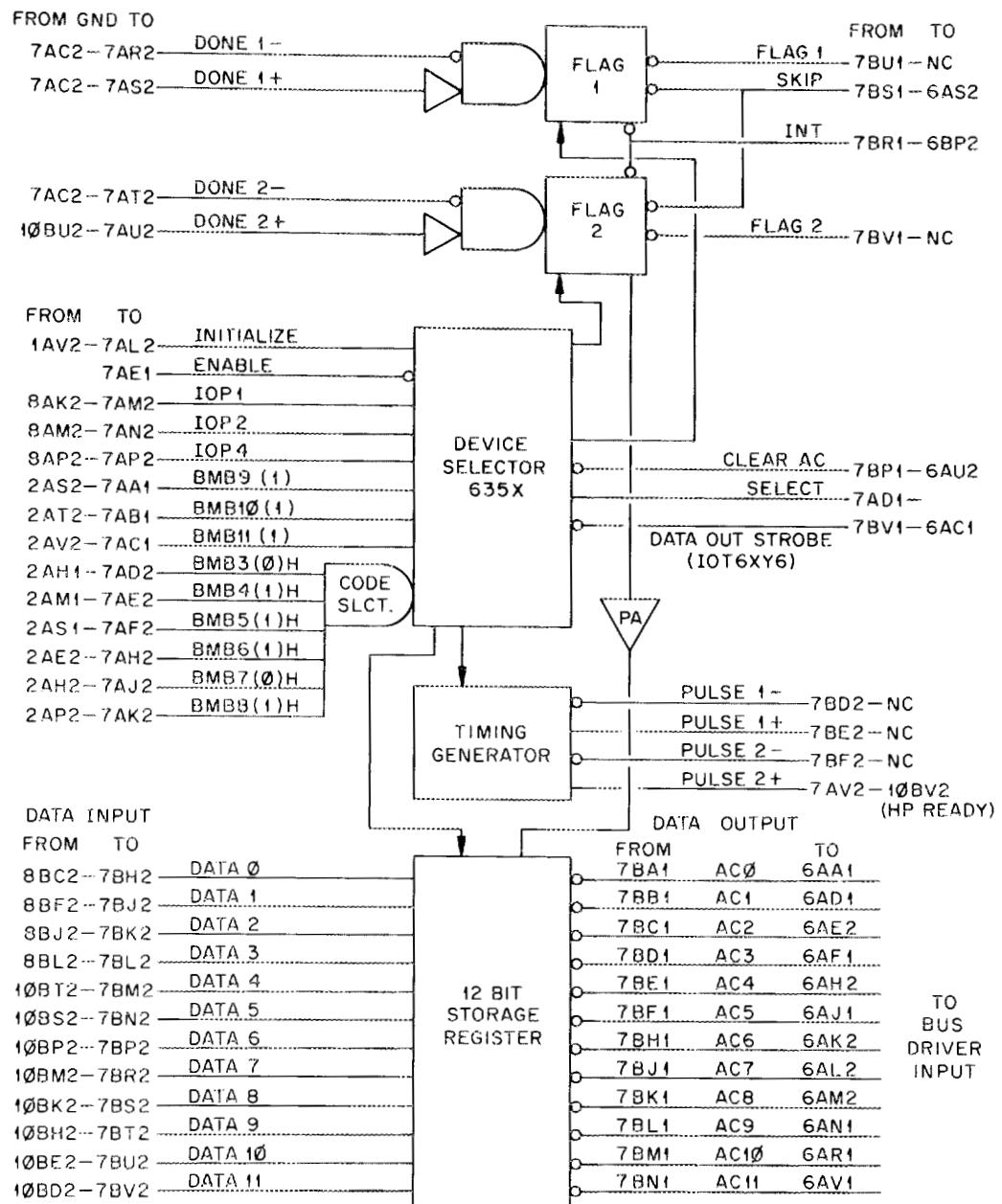


Fig. 4-6. Connections to M732 logic module (HP interface).

ORNL-DWG 70-13245

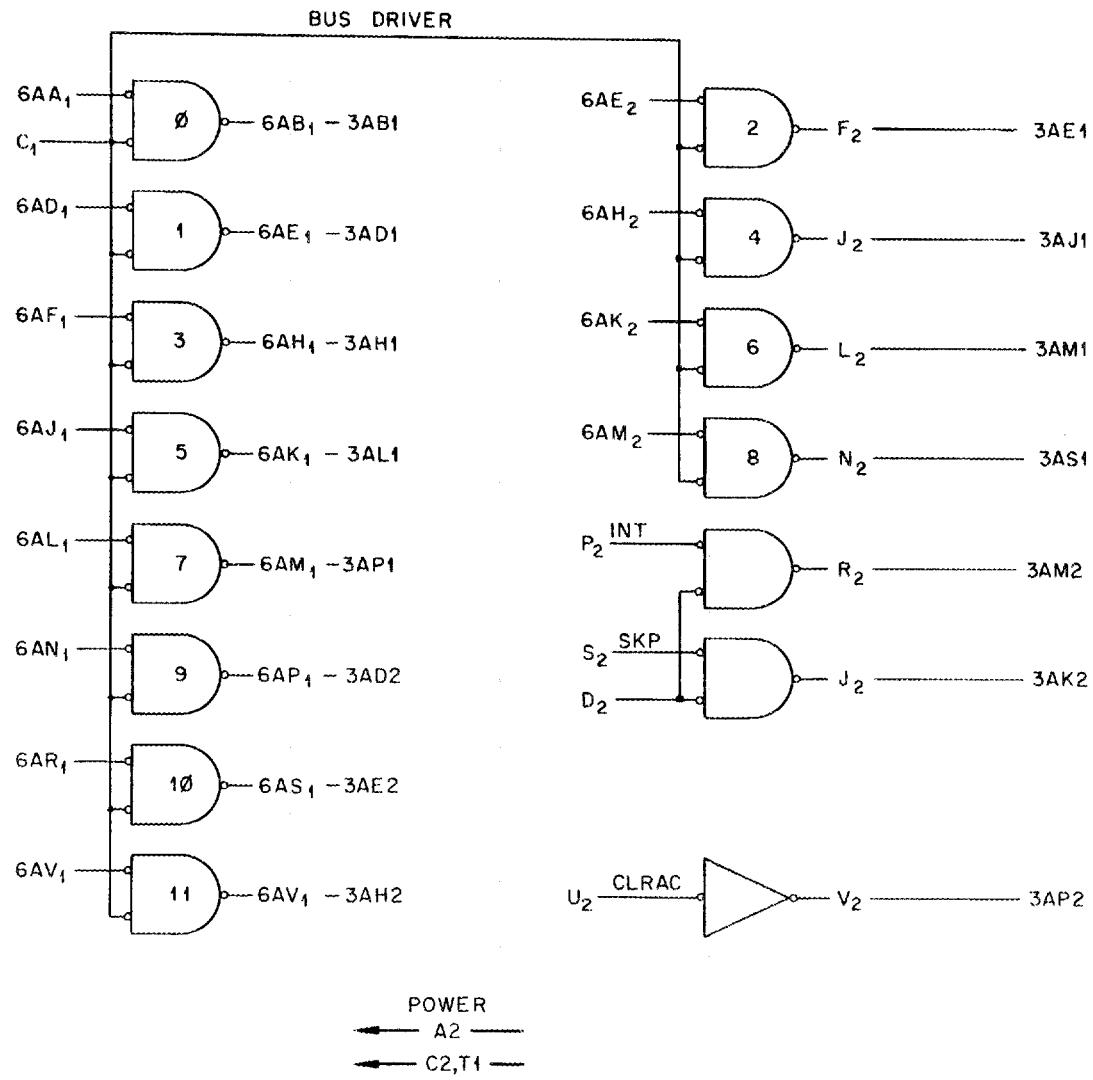
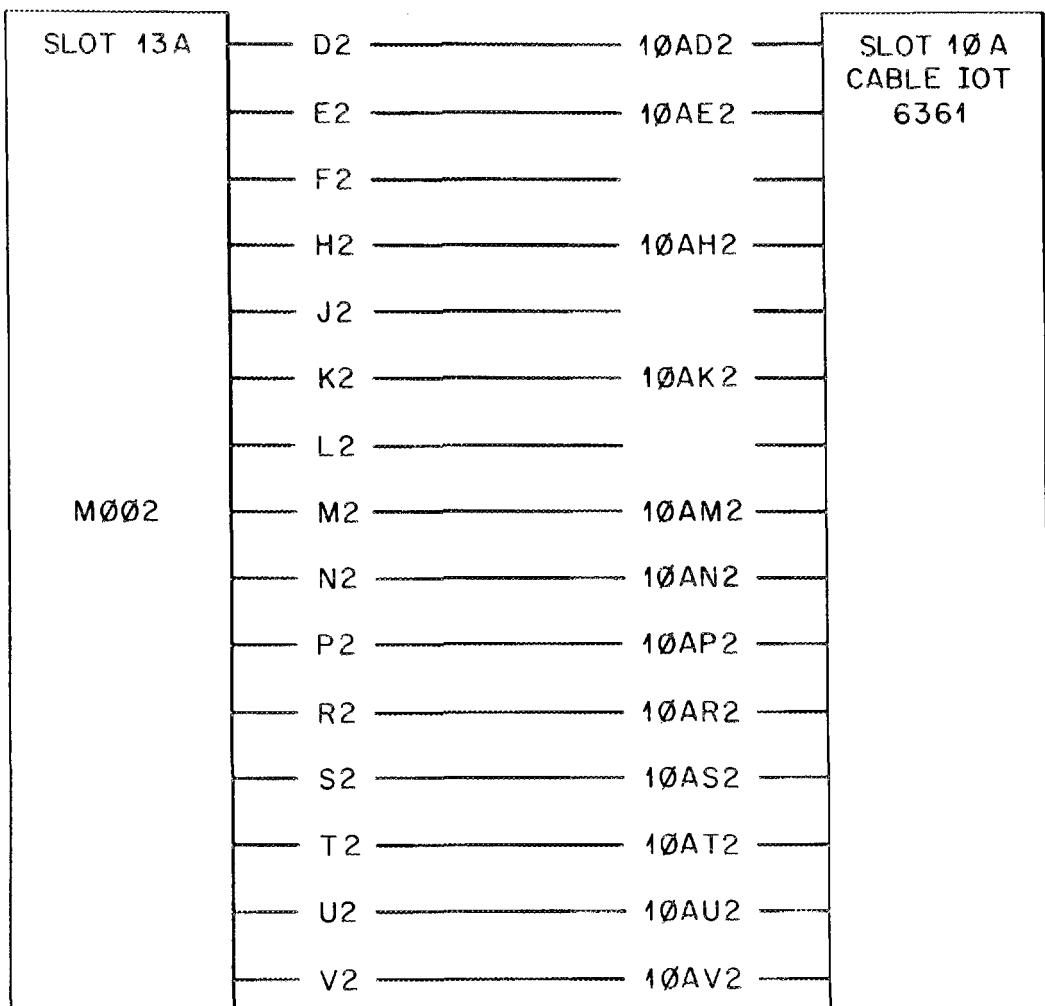


Fig. 4-7. Connections to M624 bus driver.

ORNL-DWG 70-13247



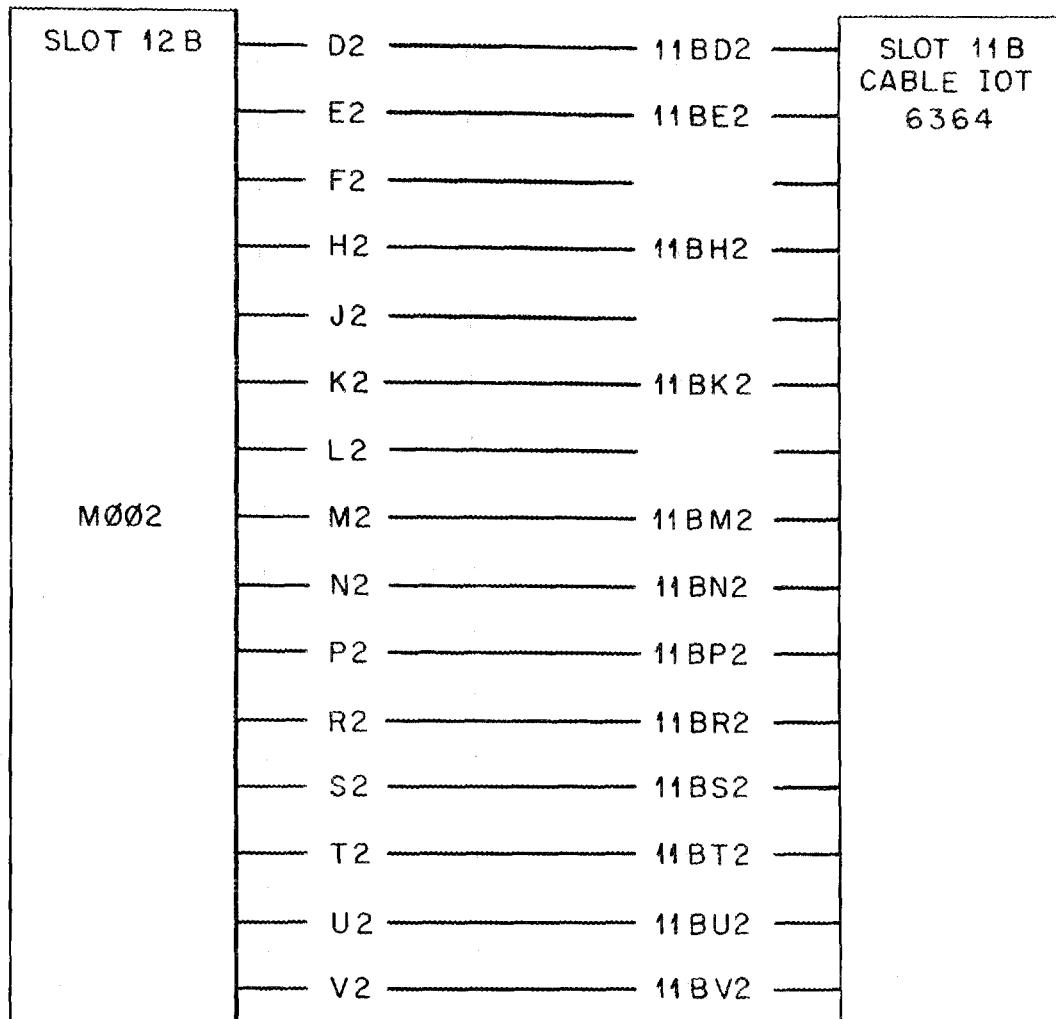
POWER

— A2 — +5V

— C2 — GRD

Fig. 4-8. Connections to Bias Supply 1.

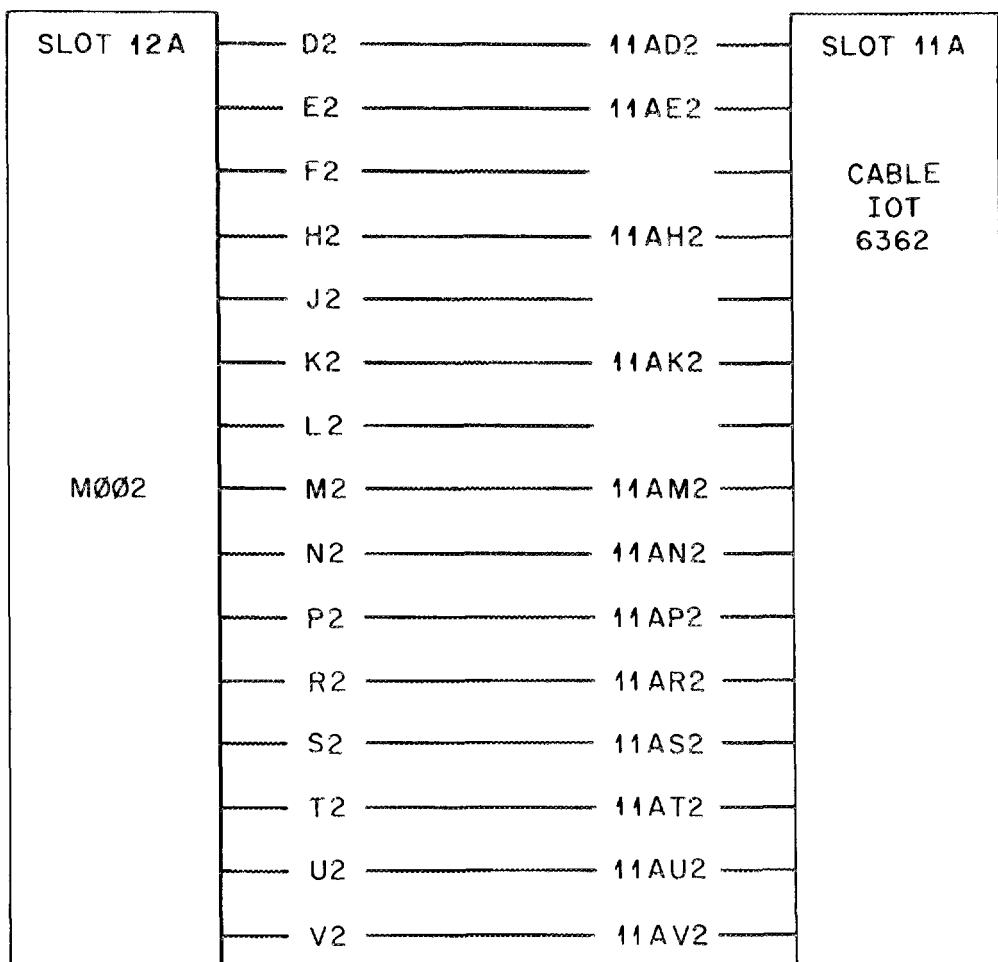
ORNL-DWG 70-13265



POWER  
A2 — +5V  
C2 — GRD

Fig. 4-9. Connections to Bias Supply 2.

ORNL-DWG 70-13264



POWER  
— A2 — +5V  
— C2 — GRD

Fig. 4-10. Connections to Bias Supply 3.