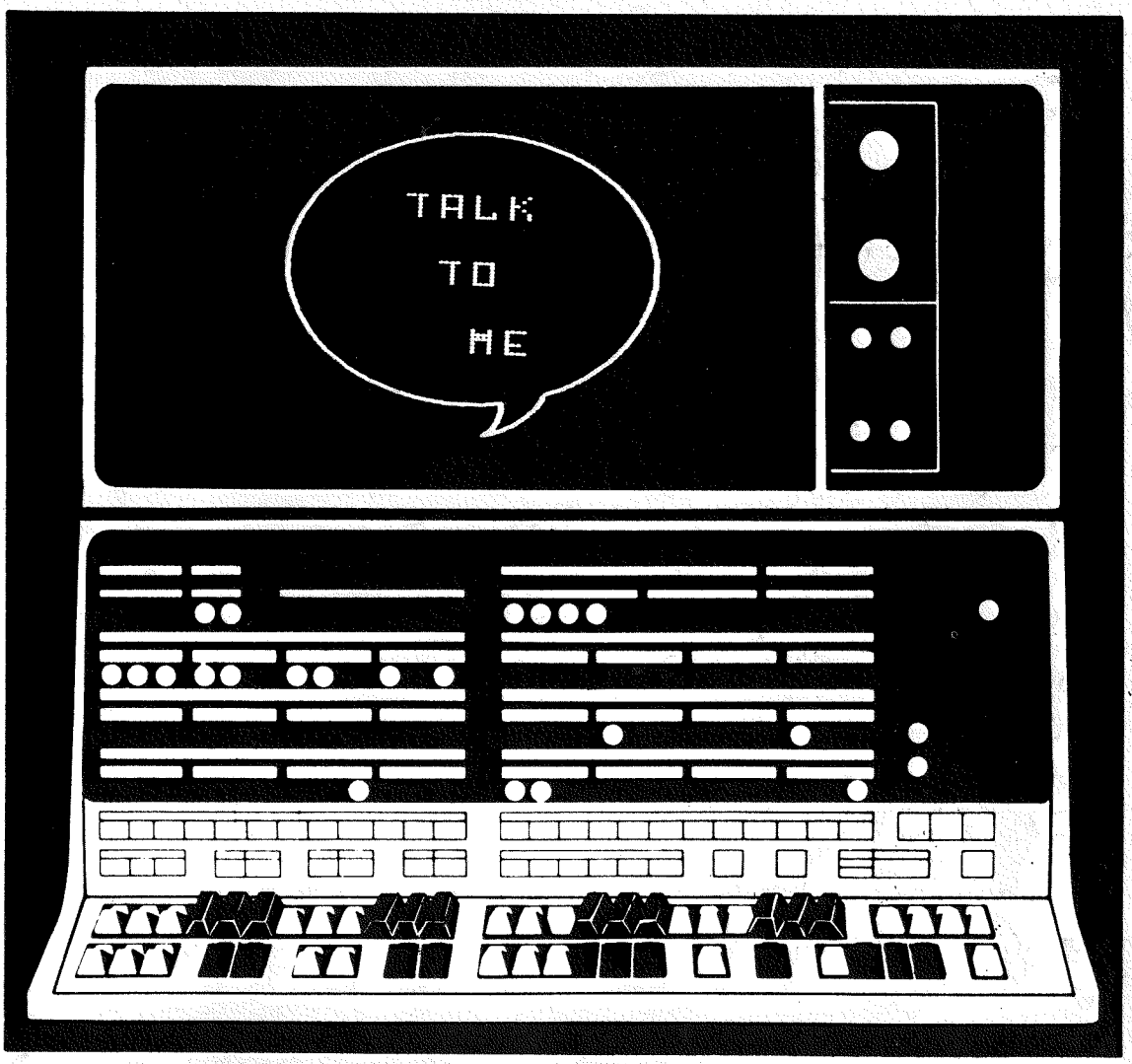
pdp12

DEMO 12
MONITOR SYSTEM
USER'S GUIDE



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DEMO12

USER'S GUIDE

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DISCLAIMER

The accompanying LINCtape entitled DIAL DEMO12 MONITOR SYSTEM 3/15/70 contains a variety of data acquisition, reduction, manipulation, and presentation programs which operate on the PDP-12A. All binaries may be loaded via the DEMO12 MONITOR and/or DIAL.

All credit for these programs belongs, in most cases, to the original authors. The only contribution of the current authors was to convert these programs to run under the DEMO12 MONITOR as a convenience to PDP-12 users. However, the question of responsibility for these programs is a difficult one. The original authors cannot be held responsible for correct operation of the modified programs in a new machine, nor can Digital Equipment Corporation claim to be responsible because of a lack of internal documentation for some of the programs. All appear to work, but it is suggested that the programs be checked out before basing any substantial conclusions on results obtained with them. DIAL sources and listings are available from the Program Library for most data reduction programs to allow program verification and modification.

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SECTION I

OPERATING PROCEDURES
HOW TO USE DEMO12

Section 1 contains all the operating procedures required for DEMO12, including starting the system, modifying scope messages and issuing commands. A tape Index is also included for easy reference.

1.1 Loading and Starting DEMO12

The procedure to load DEMO12 Monitor is as follows:

1. Mount the DEMO12 tape on tape unit Ø.

2. Mount another DEMO12 tape or a scratch LINCtape on tape unit 1. (This step is optional for most DEMO12 programs and is required only for program assembly. It will, however, increase DEMO12 program loading speed because the index on unit 1 is available.)

3. Set the switches of the tape unit(s) being used to WRITE ENABLE and REMOTE.

4. On the console, set the Left Switches to Ø7ØØ and the Right Switches to ØØØØ.

5. Rock the STOP switch on the console once to make sure the processor is stopped.

6. Set the mode switch to LINC mode and press the I/O PRESET switch.

7. Press the DO switch.

8. When the tape has stopped spinning, press the START 2Ø switch.

9. The message INITIALIZATION IN PROGRESS will appear briefly and be replaced by the TALK TO ME balloon on the scope.

   When this display appears, type C on the Teletype to display a list of the operable control keys. (Refer to section 1.3).

10. To display the index of the names of the available demonstration programs under DEMO12 Monitor control, type CTRL/I. (Refer to section 1.2.)

11. When the index is being displayed, type the name of the desired program as it is spelled in the index display and then press the RETURN key. The SUMMARY frame of the selected program will appear.

1.2 DEMO12 Tape Index

NAME	SOURCE BN	SOURCE BLKS	BINARY BN	BINARY BLKS	
LOADER.			0	1	DEMO12 Monitor (binary)
SEG01-3.			1	3	
SEG11-4.			4	4	
INITLIZ.			10	1	
GREETIN.			11	1	
BALLOON.			12	5	
SEG04-4.			17	1	
DMOINDX.			20	2	
Q AND A.			22	2	
.DA-DTST	24	2	165	3	Demonstration Programs under control of DEMO12 Monitor
.DDATA12	26	4	37	6	
.DMAGSPY	32	2	153	10	
.DFRQANA	35	2	72	11	
.DDIAL	45	1	163	2	
.EFREQ12	46	2	170	3	
.EWAVES	50	2	173	3	
.EB.BALL	52	1	176	3	
.EBASMEM	53	1	201	5	
.FSOLACE	54	1	206	2	
.FMUSIC	55	1	210	6	
.FKALEID	56	1	216	2	
.FDRAW	57	2	220	3	
.FECHASK	61	2	223	3	
.FSPCWAR	63	3	226	16	
.TDAYCOM	66	1	244	4	
.TSTPWCH	67	2	250	6	
.TCLOCK	71	1	256	5	
SCRATCH.	103	50			
GREETING			776	1	
INDEXSRC	263	5			
DIAL-V2	522	2			
MARK12			511	7	
PIP			470	21	
EX.PROG.	524	1	520	2	
AD DEMO	526	1	614	3	
BINLOAD			535	3	
L8SIM			540	3	
CONVERT			543	5	
FOCAL8K			550	23	
FOCAL4K			573	21	
CAROLS			617	11	
LOADER	635	2	637	2	
INITLIZE	641	17	660	3	
SEG0	663	34	717	6	
SEG1	725	36	763	6	
BALLOON			771	5	
04-01-70	527	2			

[1] Your index may vary slightly from this sample.

1.3 Command Keys

While under control of the DEMO12 Monitor, the following control[1] key commands can be issued at any time to perform the indicated operation.

CTRL/S - Start the demonstration program
CTRL/I - Display the index
CTRL/N - Call next program in group
CTRL/C - Continue program after interruption
CTRL/H - Display the first HELP frame; press CTRL/H again and go back to control key list

When a HELP frame is presently being displayed, two keys are operable:

F - Move forward to next HELP frame
B - Move backward to previous HELP frame

1.4 Changing the INITIALIZATION IN PROGRESS Frame

The INITIALIZATION IN PROGRESS frame which appears on the scope during startup can be customized to display another message by the procedure below. Two LINCtapes are required: the DEMO12 tape on unit Ø and a scratch LINCtape on unit 1.

1. Load LAP6-DIAL[2] by one of the procedures in section 1.6.
2. Turn A/D knob 3, which controls the cursor, all the way to the right.
3. Clear the DIAL Working Area by the command

   →CL↵[3]
4. Call the program INITLIZE into the Working Area by typing

   →AP INITLIZE,Ø↵

   The tape will spin for several minutes and part of the source of INITLIZE will appear on the scope.

---

[1] A control key command is executed by pressing down the CTRL key and simultaneously typing the letter key (in the same manner as using the SHIFT key).

[2] LAP6-DIAL is hereafter referred to as DIAL.

[3] In DIAL commands, → means press LINE FEED key and and ↵ means press RETURN key.

5. Press ALTMODE and W [1] to page backwards in the text until the underlined text shown below appears on the scope:

```
        STD
        JMP    .-4
TPDX,   Ø
HOLDON, TEXT "F     INITIALIZATION
"
        TEXT "F     IS IN PROGRESS\"
M37,    -37
/
/
/THE FOLLOWING MUST REMAIN FIXED
/
        *761
        LDF    3
DQXT,   JMP    . /RETURN FROM DCALL IN B1
```

6. Move the cursor using A/D knob 3 until it is under the last S in the word PROGRESS.

7. Use the RUBOUT key to erase all 18 characters of IS IN PROGRESS (the 18 include the four spaces at the end) by pressing RUBOUT 18 times until only HOLDON, TEXT "F remains on that line.

8. Now type in up to 18 characters of your choice for the second line of the frame. Remember that a space is considered a character.

9. Then, for the first line, use A/D KNOB 3 again to move the cursor under the last N of INITIALIZATION. RUBOUT 18 characters, then type in up to 18 characters of your own as in steps 7 and 8.

10. Turn A/D KNOB 3 fully clockwise. Reassemble INITLIZE by typing

    →AS ↵

    (There should be no errors in the assembled program.) Press the RETURN key when the symbol table starts to be printed to suppress it.

11. Store the assembled binary tape unit 1 by the command

    →SB GREETIN,1 ↵

12. Type

    → DX,1 ↵

    to display the index of tape unit 1 to determine the three blocks where the binary was stored. The display will include an entry like the following:

```
INDEXSRC  263   5
DIAL-V2   522   2
GREETIN                 530   3
MARK12                  511   7
PIP                     470   21
EX.PROG.  524   1       520   2
AD DEMO   526   1       614   3
```

[1] ALTMODE commands are typed by pressing the ALTMODE key and then the letter key.

Remember, to step forward through the index one line at a time, press the 2 key; to step backward, press the W key. Refer to the LAP6-DIAL Programmer's Reference Manual for details.

Write down the block number of the third block of the 3 block file, GREETIN. In this example, the third block number is 532.

13. Press RETURN and transfer the third of these 3 blocks to block 11 on unit Ø (DEMO12 tape) via PIP:

    Load PIP by typing the command

    →PI↵

    b. Respond to the indicated PIP displays with the reply listed.

DISPLAY	REPLY
Mode	A↵
Option	C↵
Input device	L1;532,1↵
Output device	LØ;11↵

The location 532 from the above example is used here. Substitute the third block of the value of the program GREETIN from your unit 1.

14. When the mode option frame is displayed again, stop the machine by rocking the STOP switch.

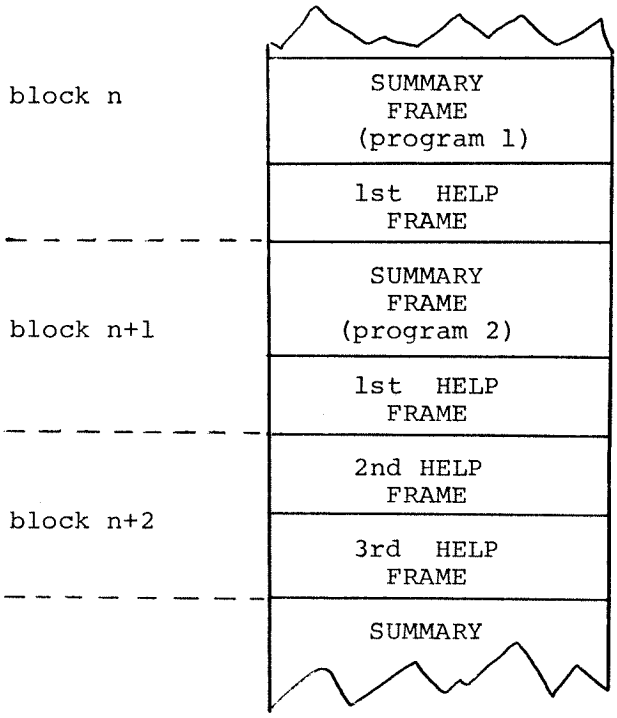
15. Reset the Left and Right Switches and load DEMO12 as in section 1.1. The new initialization frame will appear before the TALK TO ME balloon.

1.5 Modifying the Summary and Help Frames

The SUMMARY and/or HELP Frames for any demonstration program can be changed by the user by following the procedure in this section (1.5.1 to 1.5.7). It may be helpful to refer to the example in section 1.5.7.

1.5.1 SUMMARY and HELP Frame Organization

Each demonstration program in the DEMO12 system has one SUMMARY frame and at least one HELP frame. These programs are stored on the LINCtape as shown in this segment of tape:



Note that:

a. 1 block of tape = 2 frames (1 SUMMARY frame + 1 HELP frame or 2 HELP frames).

b. 1 frame = 1 display on the scope.

Because of this organization:

a. There must be an odd number of HELP frames.

b. The two frames in a block must both be transferred.

1.5.2 Mapping the Change

1. Load DEMO12 by the procedure in section 1.1. Two LINC-tapes are required, the DEMO12 tape on unit Ø and a scratch LINCtape on unit 1.

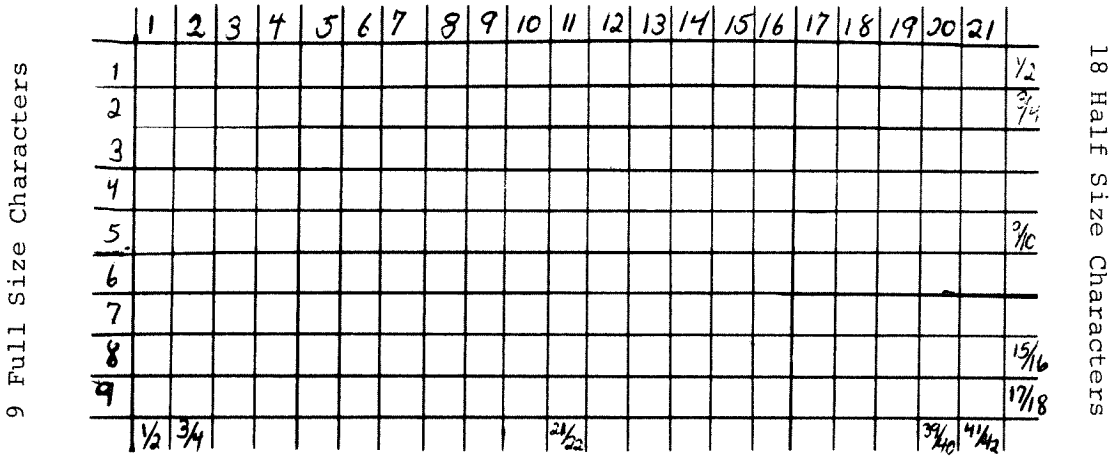
2. Display the DEMO12 index by typing CTRL/I.

3. Type the name of the program whose SUMMARY and/or HELP frames are to be changed and press RETURN.

4. Display the frame to be modified. The first source block contains the SUMMARY frame and the first HELP frame; the second block contains the second and third HELP frames. Type CTRL/H to display the first HELP frame. F can be typed to display the next HELP frame or B can be typed to step backward through the HELP frames.

5. Use a grid like the following one to map out the new display. Both half and full size characters may be used in any display, but only one size can be displayed in any line. Remember that if only one frame in a block is to be modified, the other frame must at least be recopied. Note that no more than 256 half size characters may be displayed at any time.

21 Full Size Characters



9 Full Size Characters

18 Half Size Characters

42 Half Size Characters

1.5.3 SUMMARY/HELP Frame Block Identification and Storage

1. Load DIAL by one of the procedures outlined in section 1.6.
2. Display the DEMO12 tape index by typing the command

   →DX,Ø↵

   or print it by the command (Refer to section 1.2.)

   →PX,Ø↵
3. Locate the DEMO12 program to be changed in the index. Write down the block number (BN) and number of blocks (BLKS) for the source of the program. (This is where the SUMMARY and HELP frames are located.) The SUMMARY frame and first HELP frame are located in the first block listed; the second block contains the second and third HELP frames, etc.
4. Return to the DIAL Working Area by pressing RETURN.

1.5.4 Typing the New Frame

1. Clear the DIAL Working Area by typing the command (→CL↵).
2. For the first frame in the block type *Ø
3. Move the cursor (rotate A/D Knob 3 to the left) under the zero and press RETURN.
   (this avoids the automatic tabs used by the DIAL Editor).

4. Type

```
TEXT %
```

and then F or H to indicate full or half size characters, respectively, for the first line of the frame as, for example:

```
TEXT %F
```

Note that % is arbitrarily being used as the delimiter and therefore cannot be used in the text. Any other delimiter may be used,but with the same restriction.

5. Type the first line of the frame and then press RETURN.

```
*Ø
TEXT %FSSW1...DISPLAY MODE
```

6. Type F or H to indicate character size of the next line. Then type the next line and press RETURN.

```
F=Ø...DIGIT DISPLAY
```

7. Type F or H for character size of the third line and type the text of the third line:

```
H (16 CHANNELS AT A TIME)
```

Note that typing a space and RETURN on a line after F or H leaves a blank line.

8. Continue in this manner until the frame is filled as desired.

9. Type the two characters \ % at the end of the frame. (The backslash, \ , is typed by SHIFT/L.)

10. Type the second frame of the block by proceeding as in steps 3 through 8 above ,except type *2ØØ instead of *Ø in step 2.

11. Now one block of tape (two frames) has been modified. To alter the next block (next two HELP frames) proceed as in steps 2 through 1Ø but use *4ØØ and *6ØØ instead of *Ø and *2ØØ in steps 2 and 1Ø; if more blocks are to be modified, use *1ØØØ and *12ØØ, etc., (up to *17,6ØØ).

1.5.5 Transferring Modified Frames to DEMO12 Tape

Assemble the text written in the Working Area by the command

```
→AS
```

to translate it to binary coding. (Be sure A/D Knob 3 is turned all the way to the right.)

2. When no errors are noted, store the binary on the tape on unit 1 by a Save Binary command, such as

```
→SB FRAM,1
```

3. Display the index to locate where the binary has been stored using the command

→DX, 1↵

Remember that the first block is a header block and should be disregarded.

	SOURCE		BINARY	
NAME	BN	BLKS	BN	BLKS
LOADER.			0	1
SEG01-3.			1	3
SEG11-4.			4	4
INITLIZ.			10	1
GREETIN.			11	1
BALLOON.			12	5
SEG04-4.			17	1
DMOINDX.			20	2
0 AND A.			22	2
.DA-DTST	24	2	165	3
.DDATA12	26	4	37	6
.DMAGSPY	32	2	153	10
.DFROANA	35	2	72	11
.DDIAL	45	1	163	2
.EFREQ12	46	2	170	3
.EWAVES	50	2	173	3
.EB.BALL	52	1	176	3
.EBASMEM	53	1	201	5
.FSOLACE	54	1	206	2
.FMUSIC	55	1	210	6
.FKALEID	56	1	216	2
.FDRAW	57	2	220	3
.FECHASK	61	2	223	3
.FSPCWAR	63	3	226	16
.TDAYCOM	66	1	244	4
.TSTPWCH	67	2	250	6
.TCLOCK	71	1	256	5
SCRATCH.	103	50		
FRAM			531	2
INDEXSRC	263	5		
DIAL-V2	522	2		
MARK12			511	7
PIP			470	21
EX.PROG.	524	1	520	2
AD DEMO	526	1	614	3

4. Now use PIP to move the appropriate block(s) stored on unit 1 to the appropriate area on the DEMO12 tape. Call PIP by typing

→PI↵

Respond to the displays as follows. (The values used here for input and output device are for the modification of the program A-DTST.)

DISPLAY	REPLY
Mode	A ↵
Option	C ↵
Input device	L1;532,1↵
Output device	LØ;24↵

1.5.6 Loading DEMO12

1. Load DEMO12 by the procedure in section 1.1 and call the program that was modified.
2. Observe the modified frames.
3. If they are not as desired, return to the DIAL Working Area and try again.

1.5.7 Example of SUMMARY and HELP Frame Modification

The A-DTST program is used in this example.

1. Load DIAL by one of the procedures in section 1.6.
2. Display (↦DX,Ø↵) or print index (↦PX,Ø↵) to find location of the SUMMARY/HELP frames. Note the block number and number of blocks for the A-DTST source.

```
Q AND A.                    22   2
.DA-DTST    24   2        165   3
.DDATA12    26   4         37   6
.DMAGSPY    32   2        153  10
.DFRQANA    35   2         72  11
```

3. Return to DIAL Working Area by pressing the RETURN key.
4. Clear the Working Area (↦CL↵).
5. Type *Ø and move cursor via A/D Knob 3 under Ø (*Ø) to take care of the automatic tab problem.
6. Press the RETURN key, type TEXT % and continue to type the frames as they are mapped onto the grid, including F or H for full or half size characters.

```
                TEXT  %H                          ***********************
                F          A-D TEST
                H            ***********************
                FDISPLAYS OCTAL VALUE
SUMMARY         FOR AN OSCILLOSCOPE-
FRAME           FLIKE DESPLAY OF THE
                FINPUT VOLTAGE.  DIS
                FPLAY OF INPUT WAVE-
                FFORM IS AVAILABLE.\%
                       *200
                TEXT %
                H            ******************************
                F         A-D  TEST
                H            ******************************
HELP            H
FRAME 1         FSSWØ...CHANNEL SELECT
                H
                F   =Ø..CHANNELS  Ø-17
                F   =1..CHANNELS  2Ø-37
                F
                F
                H             (MORE) \%
                *4ØØ
                TEXT  %F  SSW1...DISPLAY MODE
                H
                F     =Ø..DIGIT DISPLAY
                H                 (16 CHANNELS AT A TIME)
HELP            H
FRAME 2         F     =1..OSCILLOSCOPE-
                F         LIKE DISPLAY
                H                 (SET DESIRED CHANNEL
                H                 NO. IN LEFT SWITCHES)
                H
                F *6ØØ  CONTROL S TO START \%
                TEXT  %
HELP            F
FRAME 3         F
                F
                F      CONTROL S TO START \%
```

7. Move A/D Knob 3 all the way to the right and then assemble (→AS↵) so that there are ØØØØ errors.

8. Store the binary listing on unit 1 (→SB FRAM,1↵).

9. Locate where the binary was stored by (→DX,1↵) or (→PX,1↵).

N.B. The first block is a header block and should be ignored:

NAME	SOURCE BN	SOURCE BLKS	BINARY BN	BINARY BLKS
		:		
.TCLOCK	225	1	227	5
	241	2	243	14
LOADER	Ø	1		
BANKØ.3-	1	3		
BANK1.4-	4	4		
INITLIZ.	1Ø	1		
GREETIN.	11	1		
BALLOON.	12	5		
BANKØ.1-	17	1		
WRITABLE	11Ø	16		
DEMOINDX	2Ø	1		
QANDA	22	2		
FRAM			531	3
AD DEMO	267	1	541	3
KW12SUBC	6Ø2	5		
MARK12		.	6Ø7	7
		.		
		.		

10. Call PIP (→PI ↵) to transfer new text to DEMO12.

Select the following options.

DISPLAY	REPLY
Mode option	A↵
Option	C↵
Input device	L1;532,2↵
Output device	LØ;24↵

11. Load DEMO12 (refer to section 1.1) and call A-DTST to check the results.

12. If there are mistakes, return to the DIAL Working Area, edit (refer to LAP6-DIAL Programmer's Reference Manual), reassemble, rePIP, etc.

1.6 Loading DIAL

DIAL can be loaded by either of the following procedures.

A. Directly from tape:

1. Mount the DEMO12 tape on tape unit Ø and another DEMO12 tape or a scratch LINCtape on unit 1.
2. Set the switches of both tape units to WRITE ENABLE and REMOTE
3. Set the Left Switches to Ø7Ø1 and the Right Switches to 73ØØ.
4. Rock the STOP switch once to make sure the machine is stopped.
5. Set the mode switch to LINC Mode and then press I/O PRESET.
6. Press DO.
7. When the tape has stopped spinning, press START 2Ø.
8. The DIAL Working Area appears on the scope. You may now write a program, edit text, or give a command (make sure A/D Knob 3 is turned all the way to the right). Refer to the LAP6-DIAL Programmer's Reference Manual , DEC-12-ADRMA-A-D, for further information.

B. Via the DEMO12 Monitor:

1. Load DEMO12 by steps 1 through 1Ø of the procedure in section 1.1. Two tapes are required; mount a scratch LINCtape on unit 1.
2. When DEMO12 index frame is displayed on scope, type DIAL and press RETURN.
3. Type CTRL/S. The DIAL Working Area appears on the scope. Continue as in step 8 above.

SECTION II

DESCRIPTIONS OF DEMONSTRATION PROGRAMS

Section 2 outlines all the demonstration programs on the DEMO12 tape. The first part, section 2.1, contains write-ups of the demonstration programs under DEMO12 Monitor control which include abstracts, starting and operating procedures, and the SUMMARY and HELP frames. Listings of most of these programs are available under separate cover. The second part, section 2.2, describes the other programs on the tape; these are loaded by the DIAL system. (Refer to the LAP6-DIAL Programmer's Reference Manual, DEC-12-ADRMA-A-D for further information.)

2.1 Demonstration Programs Under Control of the DEMO12 Monitor

Each of the demonstration programs under control of the DEMO12 Monitor can be loaded through that Monitor. The Monitor must first be loaded by the procedure in section 1.1. Then type CTRL/I to display the demonstration program index. Type the name of the program as it is spelled on the scope and press the RETURN key. A SUMMARY frame appears on the scope that explains what the program does. Type CTRL/S now to load and start the program or type CTRL/H to obtain additional information from the HELP frames. CTRL/S loads and starts a program at any time after it has been selected from the index.

Seven of the demonstration programs can be loaded through DIAL. First load DIAL by one of the procedures in section 1.6. Then type →LO name,Ø↵. When the tapes stop moving, press the I/O PRESET and then the START 2Ø switches. Type the name of the program exactly as it appears in the DIAL index for name in the command above. Refer to the index in section 1.2. or type →DX,Ø↵ or →PX,Ø↵ to find the correct spelling. The demonostration programs which can be loaded and started in this manner are:

.DA-DTST
.DMAGSPY
.EWAVES
.EB.BALL
.FKALEID
.FSPCWAR
.FMUSIC (No need to press I/O PRESET and START 2Ø. Just turn up speaker)

When these programs are loaded by DIAL, no SUMMARY or HELP frames are displayed and none of the DEMO12 control keys are operable.

2.1.1 .DA-DTST or A-DTST

Analog to Digital Converter Multiplexer Text and Display

ABSTRACT

A-DTST is used to test the A/D knobs for continuity, check the basic A/D for monotonicity, and test and calibrate the preamps for gain and offset. A provision for testing sixteen additional A/D channels is included for the AM12-AG12 multiplex extension.

Three methods are provided for testing the knobs and adjusting the preamps. (NOTE: Adjustment of the latching differential amplifier or the sample and hold is not normally required. For adjustment of these modules see the appropriate maintenance manual.)

OPERATING PROCEDURES

Set all Sense Switches to Ø. Set the program for the first display. Adjust the scope intensity to a comfortable viewing level. (If any difficulty is encountered, it is a hardware problem and must be corrected before proceeding.) Note that this program does not use a fast sample mode.

The following Sense Switch settings implement the indicated action.

a) SSWØ = Ø Channels ØØ-17$_{(8)}$ are sampled and displayed.

b) SSWØ = 1 Channels 2Ø-37$_{(8)}$ are sampled and displayed.

These channels are optional on the PDP-12; if not installed, the value displayed for each channel will be 777$_{(8)}$.

c) SSW1 = 1 The channel selected by bits Ø7-11 of the Left Switches will be displayed as a full display.

d) SSW2 = 1 Channels Ø-7 are sampled and displayed as a segmented display.

e) SSW3 = 1 Channels 1Ø-17 are sampled and displayed as a segmented scope display.

f) SSW4 = 1 Channels 2Ø-27 are sampled and displayed as a segmented scope display.

g) SSW5 = 1 Channels 3Ø-37 are sampled and displayed as a segmented scope display.

The display routine for options C through G will trigger to the input if it is an AC signal with at least two bits (.4MV) of change within 15 MS for each channel.

For adjustment of the AD12/AM12/AG12 A to D converter, refer to the Checks and Adjustments section of the PDP-12 Maintenance Manual.

This test has no error routines; if difficulty is encountered with the SAM instruction, check the A to D control. If difficulty is encountered with the potentiometers, it will most likely be either the mutliplexer or the pots themselves. If difficulty is encountered with the external analog channels, check the preamplifiers.

	xxxxxxxxxxxxxxxxxxxx A-D TEST
Summary Frame	xxxxxxxxxxxxxxxxxxxx DISPLAYS OCTAL VALUE OR AN OSCILLOSCOPE- LIKE DISPLAY OF THE INPUT VOLTAGE. DIS- PLAY OF INPUT WAVE- FORM IS AVAILABLE.
	xxxxxxxxxxxxxxxxxxxx A-D TEST
Help Frames 1	xxxxxxxxxxxxxxxxxxxx SSWØ ... CHANNEL SELECT =Ø ... CHANNELS Ø-17 =1 ... CHANNELS 2Ø-37
2	SSW1 ... DISPLAY MODE =Ø ... DIGIT DISPLAY (16 CHANNELS AT A TIME) =1 ... OSCILLOSCOPE- LIKE DISPLAY (SET DESIRED CHANNEL NO. IN LEFT SWITCHES)
3	CONTROL S TO START

Demonstrates:

1. Digitizing analog inputs from potentiometers ($Ø_8$-7_8) and from 8 analog channels ($1Ø_8$-17_8) both of which can be connected to analog input devices.
2. Expandability of the AD12 to 32 input channels.
3. Verification of A/D calibration and function.
4. Generation of constants via the A/D potentiometers.

2.1.2 .DDATA12 or DATA12

ABSTRACT

DATA12 allows the user to sample any one of the 32 A/D channels and display the waveform on the scope as the data is received. A threshold is provided, as well as a sync-slope control for synchronizing on the input wave. The display can be frozen at any time, and the data manipulated by

a variation of the DATAM program. A movable cursor is provided as well as digit octal readout which gives the value of the data point under the cursor. The manipulation routine includes scaling, integration, differentiation, inversion, a bargraph, and tape reading and writing.

OPERATING PROCEDURES

DATA12 begins by displaying the first block of data read. Any of the following keys are then active:

Key	Action
A	Add the contents of the Right Switches to each datum in quarter 7; if bit Ø of the Right Switches is set, the other 11 bits are complemented and effectively subtracted from each datum.
B	Display the data as a bar graph.
D	Differentiate the waveform.
F	Run the data through a low pass filter.
H	Run the data through a high pass filter.
I	Integrate the waveform.
L	Double each datum.
O	Load the original data from quarter 6 back into quarter 7, and display the original waveform.
P	Invert the polarity of the data being displayed.
R	READ a block of tape from any of the eight LINCtape transports. Note that this operation proceeds in NO PAUSE mode; if an unselected transport is specified, the command remains lingering until replaced with a new read or write tape instruction, or until the correct transport number is set on the transport indicator.
S	Halve the displayed data.
W	Write the data being displayed onto tape. (This command proceeds in NO PAUSE mode with extended units; the same caution as specified in read (R above) applies with the additional requirement that the command "linger" until the specified unit is WRITE ENABLEd.)
X	Sample the external A/D channel specified at the rate of the decimal multiple of 5Ø microseconds selected.

After typing X, specifying the channel number and sample rate, and sampling for awhile, the following options apply:

a) Typing any key terminates sampling and returns to display the last collection of saved data points.

b) Typing Ø terminates sampling and transfers the last 256 points into the display buffer, thus treating the last 256 points collected as data. Pressing carriage RETURN returns to sampling of the last selected channel at the last selected sampling rate.

The following Sense Switches (set to 1) perform the indicated function:

Sense Switch	Action
Ø = 1	Continues sampling until the current trace of the display is complete, then terminates sampling and displays the last trace, treating it as original data.
1 = 1	Functions as a polarity slope switch for synchronizing on either the positive slope (SSW1=Ø) or the negative slope (SSW1=1) of the external A/D input.
4 = 1	Suppresses the cursor and octal readout.
5 = 1	Suppresses the Ø level baseline.

The A/D potentiometers are used as follows:

Knob	Function
Ø	Adjusts the bias level added to each sample during sampling only.
1	No function.
2	Adjusts the horizontal position of the four digit octal readout from the cursor.
3	No function.
4	Adjusts the threshold level at which the program syncs onto the level at the selected A/D channel.
5	Adjusts the position of the cursor on the waveform being displayed, and thus the point whose digitized value appears on the scope.
6	Adjusts the vertical position of the four digit octal readout from the cursor.
7	Not used by this program.

x DATA12 x

Summary Frame

.FAST SAMPLE THE A-D
..WRITE DATA ON TAPE
...MANIPULATE DATA
(differentiate, integrate
filter, scale, etc.)

Help Frames

TYPE: TO DO
A ... ADD RIGHT SWITCHES
B ... BAR GRAPH
(type C to return to data display)

1

D ... DIFFERENTIATE
F ... FILTER (LOW PASS)
H ... FILTER (HIGH PASS)

I ... INTEGRATE
2 L ... MAKE LARGER
O ... ORIGINAL DATA
P ... INVERT POLARITY
R ... READ A TAPE BLOCK

S ... MAKE SMALLER
3 W ... WRITE DATA ON TAPE
X ... NEW EXTERNAL INPUT
(return to channel select frame)

CR... REPEAT SAMPLING
(OF THE SAME CHANNEL)

SENSE SWITCHES:
Ø ... STOP AFTER 1ST
SWEEP AND DISPLAY
4 1 ... SLOPE CONTROL
(INPUT SYNCHRONIZATION)
4 ... SUPPRESS CURSOR
5 ... SUPPRESS BASELINE

KNOBS:
Ø ... SAMPLING DC BIAS
5 4 ... THRESHOLD
5 ... CURSOR
2 ... X-COORDINATE
6 ... Y-COORDINATE

Demonstrates:

1. Mathematical data analysis and manipulation visible on the VR12 display.

2. LINCtape as a data storage medium.

3. Sense Switches and A/D Knobs as a mode of interaction with the PDP-12.

4. Data acquisition via A/D converter.

2.1.3 .DMAGSPY or MAGSPY

ABSTRACT

MAGSPY provides a moving window for scanning data stored on LINCtape. The data is scanned or halted on the scope at a rate determined by the setting of A/D Knob 7. The data can be interpreted as waveforms, packed ASCII characters, or four digit octal numbers, in either half or full size characters. In the octal display, the leftmost column indicates the position of the first octal value of column two in the block currently being displayed. Therefore, each 12-bit word on tape down to the bit position on tape may be examined and identified by position in a block of tape.

OPERATING PROCEDURES

After loading MAGSPY the following message is displayed:

```
DATA BEGINS
IN BLOCK _ _ _
OF UNIT _
```

Type the starting tape block number, Ø to 777, and press RETURN. (Leading zeros are not required.) Type the tape drive number, Ø to 7, and press the LINE FEED key to begin displaying tape blocks. (Refer to DEC-12-FISA-D for operational details.) (The unit and block number display is initially in full-size character mode. However, it may appear in half-size character mode if waveform display was the last mode when returning from the text display.)

RESTART

To restart MAGSPY to select another option, tape drive, or initial starting block number, use the following procedure:

a. Press STOP
b. Set 4Ø2Ø in the Left Switches
c. Press START LS

WAVEFORM DISPLAY

When Sense Switch Ø is set,[1] the data on the tape blocks is interpreted as vertical coordinates for a point display. A vertical line marks the division between blocks. To display increasing tape block numbers, turn A/D Knob 7 counterclockwise. A clockwise rotation will move toward the beginning of the tape. A center position halts the display.

---

[1] Sense Switch n being "set" means Sense Switch n = 1.

TEXT DISPLAY

If Sense Switch Ø is not set, the data on tape is interpreted as packed ASCII characters. If Sense Switch 1 is set, the text is displayed in full-size mode; if it is not set, data is displayed in half-size mode.

The current block number and unit are displayed at the top of the scope. A horizontal bar indicates the end of the current block. A carriage RETURN on the tape will create a new source line on the display. DIAL sources are stored in packed ASCII.

Rotating A/D Knob 7 counterclockwise moves the display toward the end of the tape (BLK ØØØ follows BLK 777); rotating it in the opposite direction displays data toward the beginning of the tape. A center position maintains a steady display.

OCTAL DISPLAY

If Sense Switch 2 is set, the data on tape is interpreted as an octal 12 bit value from ØØØØ to 7777. The display takes the form of five columns of numbers. The leftmost column indicatesthe position of the first octal value of column 2 in the block currently being displayed. Therefore, each 12-bit word on tape down to the bit position on tape may be examined and identified by position in a block of tape.

Summary Frame	MAGSPY A MOVING WINDOW FOR SCANNING A LINC-TAPE
Help Frames 1	MAGSPY CONTROL SENSE SWITCH Ø: =Ø ... DISPLAY TEXT =1 ... DISPLAY WAVE FORM SENSE SWITCH 1: = Ø ... DISPLAY SMALL TEXT = 1 ... DISPLAY LARGE TEXT SENSE SWITCH 2: = Ø ... DISPLAY SYMBOLIC TEXT = 1 ... DISPLAY OCTAL TEXT
2	A-D KNOB 7: TURN CLOCKWISE TO MOVE TOWARD BEGINNING OF TAPE. TURN COUNTER-CLOCKWISE TO MOVE TOWARD END OF TAPE.

REMEMBER!

HIT RETURN KEY TO RETURN
TO DEMO MONITOR.

---

3 CONTROL S TO START

Demonstrates:

1. LINCtape as an extension of core and simultaneous read and display of data via fully buffered controller.
2. Block-oriented format of LINCtape.
3. Three methods of data translation:
    a. Analog
    b. ASCII text
    c. Octal
4. A/D knobs for user control of LINCtape and programs.
5. Easy retrieval of stored data for further study.

2.1.4 .DFRQANA or FRQANA

ABSTRACT

FRQANA performs frequency analysis resulting in thirty-two component cosine, sine, and rms spectra. Data and coefficient displays can be scaled; the original data can be resynthesized from the sine and cosine components to check visually the accuracy of the analysis.

OPERATING PROCEDURES

When the program is first started, and each time R is typed, new input data (2 blocks) can be retrieved from LINCtape by supplying values to the following message on the scope:

```
RETRIEVE DATA
(2 BLOCKS)
STARTING AT BLOCK _
UNIT _
```

Type the number of the first of two consecutive LINCtape blocks to be analyzed and press the RETURN key. Leading zeros must be typed. Type the tape unit number to be read, Ø-7, and press the LINE FEED key. The two blocks specified are read in and displayed.

Data input can then be scaled by typing L to increase the vertical scale by 50 percent or by typing S to decrease the vertical scale by 50 percent; L or S may be typed repeatedly, if desired.

To perform the frequency analysis, type F. When the analysis is complete, the display will reappear according to which display option previously had been chosen.

To compute the resynthesized waveform from the frequency components, type T. Again the display will reappear according to the display option that had been chosen. If the display option is I, input data, the second trace is the resynthesized waveform. The input data can be compared with the resynthesized waveform by turning knob 1. Knob 1 is a trace separator, affecting only the vertical display of the data. When the knob is turned fully counterclockwise, the top trace is the original data.

At any time during operation, a different display may be selected by typing the appropriate key. To select the input data and resynthesized waveform display, the user types 1. This is the display that appears immediately after a program start or restart.

The command C causes the frequency component display to appear with the cosine components on the left and the sine components on the right. These can be scaled using knob 2.

To select an rms spectrum for display, type P. This display can also be scaled by knob 2.

Each bar in the graph of the components and the rms spectra represents a single frequency component from 1 to 32, i.e., the first bar is the component for the 1 cycle signal generator, the second bar is the component for the two-cycle signal generator, etc. The absolute frequency of the analyzed waveform components can only be obtained by taking the time period represented by the 512 data points sampled; this will vary depending on the sampling rate used to collect the data. If the sampling rate were 512 points/second when the data was taken, then each bar of the graph represents the absolute components of the frequency domains 1 through 32. If the rate were 1024 points/second, then the bars represent frequencies 2, 4, 64 cps.

If, at any time, the user wishes to select new input data for analysis, he simply types R to restart the program.

KNOB COMMANDS

Knob 1	Trace separator (original data and resynthesized data)
Knob 2	Modify spectrum scale

TELETYPE COMMANDS

S	Halve data
L	Enlarge data by half
F	Generate Fourier Coefficients (do frequency analysis)
T	Resynthesize F(t)
P	Display power spectrum
C	Display sine and cosine components
I	Display input data (and resynthesize data if T had been typed)
R	Restart and retrieve data from tape

Summary Frame

FRQANA

(frequency analysis)
COMPUTATION OF THE
FREQUENCY COMPONENTS
OF WAVEFORM AND THE
RESYNTHESIS OF THEM
FROM STORED DATA.

Help Frame

	FRQANA KNOB 1 ... TRACE SEPARATOR KNOB 2 ... MODIFY SPECTRUM SCALE
1	TYPE: TO DO F ... GENERATE FOURIER COEFFICIENTS T ... RESYNTHESIZE f(t) S ... MAKE DATA SMALLER BY HALF L ... MAKE DATA LARGER BY HALF
2	TYPE: TO DO P ... DISPLAY POWER SPECTRUM C ... DISPLAY COSINE AND SINE COEFFICIENTS I ... DISPLAY INPUT DATA R ... RETRIEVE DATA FROM TAPE
3	HIT CONTROL S TO START

Demonstrates:

1. Rapid and convenient decomposition of a waveform into its components.

2. Resynthesis of data from computed coefficients and, thus, visual estimation of accuracy of the analysis.

2.1.5 DIAL

For ABSTRACT and OPERATING PROCEDURES, see Section 2.2.1.

Summary Frame

HIT CONTROL S AND
THE DIAL OPERATING
SYSTEM TAKES OVER

Help Frame

HIT CONTROL S

Demonstrates:

1. Transferring control from the DEMO12 Monitor to DIAL without using the console switches.
2. Restarting DIAL automatically by a user program option.

2.1.6 .EFREQ12 or FREQ12

ABSTRACT

FREQ12 analyzes one period of a periodic waveform into sixteen Fourier components and displays the power spectrum continuously on channel Ø and the incoming data on channel 1 of the scope.

OPERATING PROCEDURES

If all Sense Switches are down, a waveform determined by knob 7 is generated (into locations 3ØØ-467). Setting Sense Switch Ø up will freeze the waveform, display the Fourier components plotted as a bar histogram, and display the relative value of the component on which the cursor rests. The Fourier components are displayed as a power spectrum with the Y-axis equal to A^2+B^2, where A is the sine and B is the cosine coefficient.

The cursor may be moved via knob Ø when Sense Switch Ø is set. The position of the cursor readout may be altered with knobs 4 and 6. In the readout, n = the frequency component that the cursor rests on; xxxx is the relative value of the nth component, and SF is the scale factor of the Fourier Components. The scale factor is determined by the right three bits of the Right Switches when Sense Switch Ø is down (=Ø).

Right Switches = Ø is the largest scale factor
Right Switches = 7 is the smallest scale factor

To sample data from any desired A/D channel, stop FREQ12, change the contents of locations 52 and 267 to SAM N=100+N where N is the desired channel, and then press START 2Ø.

Summary Frame	(FOURIER ANALYSIS) THIS PROGRAM WILL ANALYZE A WAVEFORM INTO 16 FOURIER COMPONENTS. A CURSOR IS PROVIDED TO READ OUT THE AMPLITUDES.
Help Frames	FREQ12 SENSE SWITCH Ø:
1	=Ø GENERATE WAVEFORM WITH KNOB 7 =1 DISPLAY COMPONENTS
2	WHEN SENSE SWITCH Ø=1 KNOB Ø - MOVES CURSOR KNOB 4 - HORIZ. POSIT. OF READOUT KNOB 6 - VERT. POSIT. OF READOUT
3	SCALE FACTOR EQUALS: RIGHT SWITCH SETTING WHEN YOU CHANGE SENSE SWITCH Ø FROM A Ø SETTING TO 1.

Demonstrates:

1. On-line Fourier decomposition of a waveform (quantitative first approximation at Fourier analysis).
2. Simultaneous acceptance of data on-line, complex computation with that data, and display of the results.
3. User interaction via Sense Switches.
4. Use of the two scope channels.

2.1.7 .EWAVES or WAVES

ABSTRACT

WAVES produces a model of a sound wave with reflection generation and harmonic beating on the scope.

OPERATING PROCEDURES

Upon loading WAVES, a traveling sine wave is generated on the scope. Set all Sense Switches down initially. The following controls are available:

When Sense Switch 2 = Ø:

Knob 5	controls the frequency of the sine wave
Knob 7	controls the amplitude of the sine wave

When Sense Switch 2 = 1:

Knob 6	determines the waveform generated by sampling the value of this knob; time is constant. (This is used to generate your own waveshape.)

Knobs 5 and 7 are inoperative when SSW2 = 1.

Other Sense Switches:

SSWØ=1	causes the wave to reflect off the scope's edge.
=Ø	no reflection
SSW1=	determines polarity of reflection when SSWØ is up.
=1	positive reflection
=Ø	negative reflection
SSW3=1	freezes waveform
=Ø	traveling waveform

Summary Frame	SIMULATION OF SOUND WAVES MOVING IN AIR
Help Frames	START WITH SENSE SWITCHES AT ZERO
1	SINE WAVE CONTROL: KNOB 5 - FREQUENCY KNOB 7 - AMPLITUDE KNOB 6 - GENERATE WAVEFORM IF SENSE SWITCH 2=1
2	SENSE SWITCH Ø: =1 - REFLECT WAVE OFF SCOPE EDGE =Ø - NO REFLECTION

SENSE SWITCH 1:
=1 - POSITIVE REFLECTION
=Ø - NEGATIVE REFLECTION

SENSE SWITCH 3:
=1 - FREEZE WAVEFORM
=Ø - TRAVELING WAVEFORM

---

3 CONTROL S TO START

Demonstrates:

1. Interactive physical model (PDP-12 Simulation); WAVES permits sound wave parameter modification and immediate display of result.

2.1.8 .EB.BALL or B.BALL

ABSTRACT

B.BALL displays a bouncing ball's path on the scope; the resiliency of the ball and the height from which it will be dropped are the adjustable parameters.

Knob Ø of the A/D converter controls the height of the ball for the initial drop; analog channel knob 1 of the A/D converter controls the elasticity of the ball and can be varied from Ø% to a theoretical 1ØØ%.

OPERATING PROCEDURES

A/D Knobs:

Ø - controls height from which ball will be dropped.
1 - controls resiliency of the ball (from Ø% to a theoretical 1ØØ%).

Sense Switch:

Ø=1 freezes the path of the ball.

Summary Frame

* B. BALL *
(bouncing ball)
CONTROL THE RESILIEN-
CY OF THE BALL AND
THE HEIGHT FROM WHICH
IT IS DROPPED.

Help Frame

KNOB Ø ... CONTROLS HEIGHT
OF FIRST BOUNCE
KNOB 1 ... CONTROLS RESILIENCE
OF BOUNCES THEREAFTER

SWITCH Ø=1 FREEZES PATH
OF THE BALL

Demonstrates:

1. Simulation of a physical event permitting user interaction through A/D knobs and Sense Switches.

2.1.9 .EBASMEM or BASMEM

ABSTRACT

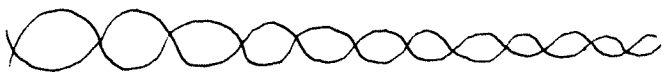
BASMEM displays a simplified model of sound wave transmission through the cochlea in the inner ear to the basilar membrane. Any point of time may be selected; the amplitude of the incoming sound wave can be adjusted.

OPERATING PROCEDURES

Knob 1 controls the amplitude scale factor and should be adjusted when the program is started. Knob Ø allows selection of any point in time. Note that the frequency of the sound wave is constant.

The wave should appear as follows (traveling to the right):

If this is the case (below), adjust the amplitude (knob 1) until the model is accurate, as:



Remember, this model is a linear display of the circular cochlea. The phase read-out is in radians (octal).

If Sense Switch 1 = 1, a movable phase indicator (a cursor controlled by knob 2) appears along with the phase value. Phase is indicated relative to the base of the cochlea.

* BASMEM *

Summary Frame

A MODEL ILLUSTRATING
SOUND TRANSMISSION
IN THE INNER EAR
THROUGH THE COCHLEA
TO THE BASILAR
MEMBRANE

Help Frame

BASMEM

KNOB Ø:
ALLOWS SELECTION
OF A POINT IN TIME

KNOB 1:
ADJUSTS THE AMPLITUDE
OF INCOMING SOUND WAVE

SENSE SWITCH 1=1:
KNOB 2 WILL
CONTROL CURSOR
(GIVES DISTANCE INTO THE
COCHLEA IN RADIANS)

Demonstrates:

1. Interactive simulation of a biological phenomenon - compression of sound from the spiral cochlea to the basilar membrane.

2.1.10 .FSOLACE or SOLACE

ABSTRACT

SOLACE displays both a martini of variable size and an olive on different D/A channels.

OPERATING PROCEDURES

If the display channel switch (above upper right hand corner of scope) is set to 1&2, both martini and olive are displayed; channel 1 displays only the martini, channel 2 displays only the olive. The level of fluid in the glass will automatically go down as the computer drinks the martini. It them refills the glass and drinks another martini.

A/D knob Ø will vary the size of the martini; the size of the olive remains constant.

* SOLACE *

Summary Frame

ALLEVIATION OF GRIEF
OR ANXIETY

Webster's Collegiate
Dictionary, 1961

SOLACE

Help Frame

KNOB Ø .. GLASS SIZE

CHAN 1 .. DISPLAY GLASS
CHAN 2 .. DISPLAY OLIVE
CHAN 1&2 .. DISPLAY
BOTH

CONTROL S TO START

Demonstrates:

1. Two independent VR12 scope channels.
2. A/D Knobs to change operating parameters.

2.1.11 MUSIC

Summary Frame

THIS PROGRAM IS
RATED "R".....
FOR RELAXATION ONLY

Help Frame

TURN UP THE SPEAKER VOLUME
AND JUST LISTEN!

CONTROL S TO START

Demonstrates:

1. Presence of a speaker usually used for audio checking of data input and for diagnostic programs.

2.1.12 .FKALEID or KALEID

ABSTRACT

KALEID displays a kaleidoscope pattern on the scope and can be simply modified to output onto an XY12 plotter. If the speaker is turned up, interesting tone patterns are audible.

Summary Frame

KALEIDOSCOPE
"POP ART"
ON THE
GREEN MACHINE

Help Frame

HAVE FUN!

ADJUST THE PICTURE
WITH KNOB 7

TRY THE SPEAKER TOO.

2.1.13 .FDRAW12 or DRAW12

ABSTRACT

DRAW12 permits the user to create straight line drawings on the scope.

OPERATING PROCEDURES

Four knobs are used to control the drawing of a line:

Knob Ø	controls the y-coordinate of one end of the line
Knob 2	controls the y-coordinate of the other end
Knob 1	controls the x-coordinate of one end of the line
Knob 3	controls the x-coordinate of the other end

To fix a line onto the scope, type any key on the keyboard. All previous lines fixed will be displayed simultaneously.

To erase the last line fixed, press the DELETE or RUBOUT key. Successive typing of RUBOUT will delete all stored lines.

To begin a new drawing either restart the program or delete all lines of the old drawing.

A simple modification to this program is to sample knob 5 to vary the number of blank points to skip before display of the lines. That is, the line described by the coordinate pairs 12,Ø; Ø,Ø would normally contain 13 displayed points but by varying knob 5 the line can display every other point, thus reducing flicker.

Summary Frame

```
(PDP-12 DRAWING PAD)

THIS PROGRAM CULTIVATES
 LATENT ARTISTIC TALENT
  BY PERMITTING THE
 OPERATOR TO CREATE
STRAIGHT LINE DRAWINGS
 ON THE PDP-12 SCOPE.
```

Help Frame

```
KNOB Ø - Y coordinate of start of line
KNOB 1 - X coordinate of start of line

KNOB 2 - Y coordinate of end of line
KNOB 3 - X coordinate of end of line

TYPE:                TO DO:
 F          - FIX A LINE
 RUB-OUT    - DELETE A LINE
 CARRIAGE RETURN - START OVER

CONTROL S TO START
```

2.1.14 .FECHASK or ECHASK

ABSTRACT

.ECHASK (Etch-a-Sketch) displays the path of a dot which can be moved horizontally and vertically using the A/D knobs and Sense Switches.

OPERATING PROCEDURES

After the program ECHASK is loaded, a dot is displayed on the screen. Move the dot horizontally by rotating A/D knob Ø and vertically by rotating knob 4. As the dot moves, its path is recorded and displayed. ECHASK will display up to $17ØØ_8$ points before filling its buffer. Sense Switches 3, 4, and 5 provide the following capabilities:

Sense Switch	Setting	Effect
5	Ø	None
5	1	Erases display

Sense Switch	Setting	Effect
4	Ø	Freezes display when buffer fills.
4	1	Erases points from beginning of display while adding new points to the tail of the etch.
3	Ø	Normal display mode, accepting contiguous points.
3	1	Continues displaying new points as dot is moved but, after switch is restored to Ø, erases dots accepted when switch was set to 1.

Summary Frame	* ECHASK * (Etch-a-Sketch) THIS PROGRAM TRACES THE PATH OF A DOT AS YOU MOVE IT ACROSS THE SCREEN.
Help Frame 1	KNOB Ø - moves dot vertically KNOB 4 - moves dot horizontally SENSE SWITCH 5: =1 - erase screen
2	SENSE SWITCH 4: =Ø - stop when buffer is full =1 - when buffer fills, begin erasing from beginning
3	SENSE SWITCH 3: =Ø - trace continuous path of dot =1 - erase segment drawn while switch = 1 This switch allows user to draw disjointed line segments. CONTROL S TO START

2.1.15 .FSPCWAR or SPCWAR

ABSTRACT:

A tactical battle between two space vehicles armed with explosive rockets is simulated on the scope. Control is effected through the analog knobs and Sense Switches, although provision has been made to use external analog input and external sense lines.

SPACEWARE OPERATING PROCEDURES

Initialization

SPCWARØ is started at address 4Ø2Ø in LINC mode; SPCWAR1 is called from the demo library by typing SPCWAR, which functions as a linking loader for the main program. Both start the program with the following display:

display 1

```
* * * * * * *
* SPACEWAR  *
* * * * * * *
```

The inital display disappears after a few seconds automatically or can be replaced by pressing RETURN or LINE FEED. The next display is:

display 2

```
DO YOU HAVE JOYSTICKS AVAILABLE?
TYPE Y OR N, THEN L/F
```

Answering "N" to display 2 generates:

display 3

```
DO YOU HAVE FIRING BUTTONS AVAILABLE?
TYPE Y OR N, THEN L/F
```

A response of "N" to display 3 generates:

display 4

```
SENSE SWITCH Ø FIRES
WHITE MISSILES
SENSE SWITCH 5 FIRES
BLACK MISSILES
```

This display will time out and be replaced by:

display 5

```
EACH SHIP WILL START
WITH 2Ø MISSILES
GOOD LUCK AND
GOOD HUNTING!
```

After this display is timed out, the main part of the program is stated.

A response of "Y" to the joystick option, display 2, generates:

display 6

```
WHAT CHANNELS DO YOU
WANT TO USE?

WHITE Y_____
WHITE X_____
BLACK Y_____
BLACK X_____
```

Type in each A/D channel as two digits, ØØ to 37. Press RETURN after each channel and LINE FEED after all channels are entered. The main program will now look at the specified channels for velocity information. The program then returns to display 3.

Answering "Y" to the display 3 generates:

display 7

```
ARE YOU GOING TO
PLUG FIRE BUTTONS INTO
ANALOG CHANNELS?
TYPE Y OR N THAN L/F
```

Answering "N" to display 7, causes display 4 to appear.

Answering "Y" to display 7 generates:

display 8

```
WHAT CHANNELS?
WHITE FIRES_____
BLACK FIRES_____
```

Typing a line feed prior to inputting the fourth number causes a return to display 6; typing a line feed after the fourth number causes a return to display 4.

Main Program

The initialization routine terminates by resetting the score and missile count and displaying the following message:

```
* * * * SPACEWAR * * * *
SET ALL KNOBS TO ZERO
THEN HIT LINEFEED
A X (Ø):+NN
A Y (4):-NN
B X (3):+NN
B Y (7):-NN
KNOBS 1, 5, 2, 6
CONTROL HAZARDS
```

Knobs Ø and 4 control the white ship, 3 and 7 the black ship. The hazards are simulated asteroids; striking an asteroid with a ship or moving an asteroid into a ship will destroy that ship.

Set all four ship channels to zero and then press LINE FEED. The ships and asteroids will appear, unless an asteroid happens to be occupying the same position as a ship, in which case there is a small thermonuclear reaction; try again.

When any of the velocity knobs are displaced from zero, the associated ship will move in the direction commanded. Missiles are fired by

changing the position of the Sense Switches or the external level voltage. Missiles have a velocity of $V = 2V_x^2 + 2V_y^2$ of the ship at the instant of firing. Missiles which travel over the scope boundaries are erased, although the ships will "wrap-around" to the other side of the scope.

2.1.16 .TDAYCOM or DAYCOM

ABSTRACT

DAYCOM (day computer) foretells or retells the day of the week for twentieth century dates.

OPERATING PROCEDURES

Upon loading DAYCOM, the following is displayed on the scope:

```
THE DATE
??/??/19??
```

Type the number of the month, the date of the month, the year - each followed by a carriage RETURN. Note that leading zeros are not required. DAYCOM responds with the day of the week on which the date will occur or has occurred. Press carriage RETURN a fourth time to initialize the display and type another date.

(NOTE: DAYCOM does not check for nonexistent dates).

Summary Frame

```
DAY OF THE WEEK
  COMPUTATION
FOR ANY DATE IN
THE 2ØTH CENTURY
```

Help Frame

```
TYPE:
  MONTH-DAY-YEAR
    (FOLLOW EACH WITH RETURN KEY)

LEADING ZEROS NOT
    REQUIRED

TO RESTART PROGRAM, HIT RETURN KEY.

     NOW CONTROL S TO START.
```

Demonstrates:

1. Use of a question and answer subroutine.

2.1.17 .TSTPWCH or STPWCH

ABSTRACT

STPWCH (stopwatch) utilizes the KW12 to generate timing marks every 0.1 seconds and an update of the display to reflect the passage of time. Two subroutines, QANDA and KW12SUBC, are used, plus a short additional program to generate STPWCH. This latter program is responsible for setting up the display buffer, checking for clock timing marks, and implementing the two Teletype commands.

OPERATING PROCEDURES

Upon loading STPWCH, the display below appears on the scope. Type T to start the stopwatch initially and typing S stops the clock and displays the last count. Type T again to zero the minutes, seconds, and tenths of seconds indicators and restarts the clock.

Summary Frame	* STPWCH * A PDP-12 STOPWATCH USING THE KW12 REAL TIME CLOCK
Help Frames 1	TYPE: TO DO: T - START TIMING S - STOP THE WATCH CONTROL S TO START
2	IF THERE IS NO KW12 IN THE SYSTEM, THE PROGRAM SUGGESTS A PURCHASE.
3	CONTROL S TO START

Demonstrates:

1. KW12 real time clock.

2.1.18 .TCLOCK or CLOCK

ABSTRACT

CLOCK displays a clock with an hour, a minute, and a second hand. Watch time fly.

OPERATING PROCEDURES

Upon loading CLOCK the following display appears on the scope:

HRS?? MIN??

Type in the appropriate hour, press RETURN, type the minutes and press RETURN.

The clock is displayed set to the time that was typed. The second hand will sweep 360° in 1 second (±20%[1]); the minute and hour hands will sweep accordingly. The clock can be reset by pressing any key on the keyboard, causing HRS?? MIN?? to be displayed again.

By setting Sense Switch Ø = 1, the clock will step its speed to that of a stopwatch. The second hand will sweep 360° once every second,[1] the minute and hour hands will sweep accordingly.[2]

Summary Frame

DISPLAY A CLOCK FACE:
SET THE TIME AND
WATCH THE MINUTES
GO BY.

Help Frame

TYPE THE TIME:

HOURS/MINUTES
(EACH FOLLOWED BY RETURN KEY)

TO RESET, HIT RETURN.

SENSE SWITCH Ø=1:
WATCH TIME FLY

CONTROL S TO START

Demonstrates:

1. Q & A subroutine, VR12, and Sense Switches.

---

[1]The clock program uses its own timing loop to determine sweep rate; therefore, all timing will be ±20%.

[2]Once the clock rate has been increased, it can be reset by typing any key.

2.2 Programs Under Control of DIAL

The following programs are also on the DEMO12 tape and are of a more practical nature than most of the demonstration programs on the tape. All of the following programs require DIAL to be loaded by the procedure in section .

2.2.1 DIAL

is the Display Interactive Assembly Language written for the PDP-12 and provides the user with a keyboard operating system for editing, assembling, and file handling. DIAL starts in the edit mode. Refer to the LAP6-DIAL Programmer's Reference Manual, DEC-12-ADRMA-A-D, for details. See Section 1.6 for Loading Procedures.

2.2.2 MARK12

formats and verifies certified and uncertified LINCtapes for the PDP-12 in standard format (256 words/block) or a special 129 words/block format. MARK12 formats the tape, writes a pattern in each block, and checks all its operations, including checksums and block numbers. (If only DECtape is available, it can be rewound and then formatted using MARK12.) Call the program by →LO MARK12,Ø↵ and follow the instructions on the scope.

2.2.3 PIP

is the Peripheral Interchange Program which transfers source or binary information between input/output devices, including LINCtape, high-speed and Teletype reader/punch, card reader and line printer. Whole files or individual blocks may be transferred. PIP is called from DIAL by →PI↵ and once started may be restarted by typing CTRL/P. Refer to the DIAL manual for more detailed information.

2.2.4 EX.PROG

demonstrates the power of the PDP-12 Instruction Set by using just eight instructions to sample two A/D channels based on the setting of Sense Switch Ø, display the sampled data and write it onto LINCtape for later inspection by .MAGSPY. EX.PROG is called by LO EX.PROG,Ø .

2.2.5 AD DEMO

loads the DEMO12 Monitor System from tape while using DIAL. The call is →LO DEMO,Ø↵ .

2.2.6 BINLOAD

reads and stores information on binary coded paper tape into the PDP-12 via the high-speed or Teletype reader. All diagnostic messages are ignored. To use the loader, type →LO BINLOAD,Ø↵ . Put the paper tape in the reader, set the reader to START, and press START LS on the console.

2.2.7 L8SIM

traps LINC-8 and classic LINC Teletype input and output instructions and then simulates them for PDP-12 operations. Control is returned to the user program after simulation of the instruction. The L8SIM loading procedure is

1. Type →LO L8SIM,Ø↵.
2. Replace the DEMO12 tape with a LAP4 or LAP6 tape.
3. Press I/O PRESET.
4. Set the Left and Right Switches to

   Ø7Ø1 1Ø1Ø
5. Proceed in the LAP4 or LAP6 manner.

2.2.8 CONVERT

translates a LAP6 or LAP6-3L source program on LINCtape to source usable by DIAL. To use CONVERT, mount the LAP6 tape containing the source program to be translated on unit 1. Type →LO CONVERT,Ø↵ to start the conversion.

2.2.9 FOCAL4K, FOCAL8K

The FOrmula CALculator programs are the 4K and 8K versions of the language designed at DEC to help students, engineers, and scientists solve numerical problems. The language consists of imperative commands and mathematical expressions typed primarily in standard notation. Both versions of FOCAL use 1K of lower memory for variables; FOCAL8K stores its text in upper memory and FOCAL4K uses lower memory. FOCAL8K permits many more variables and longer programs. Load the appropriate version of FOCAL by →LO FOCAL8K,Ø↵ or →LO FOCAL4K,Ø↵.

2.2.10 CAROLS

provides musical entertainment appropriate for the Holiday Season. Load the program by →LO CAROLS,Ø↵ and turn up the speaker volume.

2.3 DIAL Demonstration

The following sequence is designed to highlight the important features of the PDP-12 DIAL system including its editing capabilities, assembly techniques, binary and source program storage, program execution, and additions and deletions to the tape index. Start DIAL by one of the procedures in Section 1.6.

1. When the DIAL Working Area is displayed, clear it by typing →CL↵ .

1

2. Write a simple program, such as the one that follows which displays a line on the scope.

```
1           *2Ø
2           SAM 1
3           DIS I  3
4           JMP .-2
```

3. To demonstrate the editing feature of DIAL:

   a) Move the cursor with A/D Knob 3 until it is under the 3 in DIS I 3.

   b) Press the RUBOUT key to erase the 3.

   c) Type 1 so the instruction now reads DIS I 1

   d) Move Knob 3 counterclockwise until it is under the 1 in SAM 1.

   e) Press RUBOUT.

   f) Type 2 so the instruction is SAM 2.

   g) Move knob 3 all the way back to the right by rotating it clockwise.

   h) Move knob 7 to display varied numbers of lines of text.

4. Assemble the program by typing either the command →AS↵ which performs the assembly or the command →LI↵ which assembles the program and lists it on the Teletype (or line printer, if available).

5. Store the program on tape as

   a) binary, by typing →SB LINE,1↵ to store the program named LINE on tape on unit 1,

   or

   b) source, by typing →SP LINE,1↵ to store the source program named LINE on tape on unit 1. To produce a hard copy of the source, type →PS LINE,1↵ .

   (Any other unused program name can be used in this step. Be sure to continue to use that name in the remaining steps also.)

6. Check the tape index on unit 1 to show that the new program, LINE, has been stored by the command →DX,1↵ .

   Page through the index by pressing the ALTMODE key commands until the program LINE source (S) and/or binary (B) is displayed. The program name, type (source or binary), beginning block number on tape (BN), and number of blocks (BLKS) used are included in the display.

1

This program's origin is at location 2Ø. It samples channel 1, digitizes it and displays it on the scope. The "I" causes autoindexing and thus the display of a line instead of a point. The JMP instruction causes a closed loop.

The following ALTMODE commands can be used:

ALTMODE key, 1	Forward one frame
ALTMODE key, 2	Forward one entry
ALTMODE key, Q	Backward one frame
ALTMODE key, W	Backward one entry

A program stored on tape may be deleted from the tape by the following steps:

a) Step through the index until the last line displayed on the screen is the file that is to be deleted.

b) Press RUBOUT once; the line will disappear.

c) Type R if the file is to be restored or eliminate it by typing : (colon) to make the deletion permanent.

7. The index can be printed, if desired, by typing → PX,1 ↵.

To return to the DIAL Working Area, press the RETURN key.

8. To execute the program LINE:

a) Type

→LO LINE,1↵

to load it into core.

b) Press the I/O PRESET switch

c) Press the START 2Ø switch.

A line will be displayed on the screen. Rotate knob 2 to the left and right to move the line up and down. This program is sampling potentiometer 2 and displaying the data on the scope.

9. Stop the program by rocking the STOP switch back and forth.

10. To reload DIAL, refer to section 1.6.

APPENDIX A

KW12, REAL TIME CLOCK, SUBROUTINE SETUP PACKAGE

1. ABSTRACT

This package of subroutines contains the necessary fixed protocol required to start the KW12 Real Time Clock. The main program need only specify the working settings of the clock control register, the clock enable register, and the buffer register. Note that this subroutine package is designed only to initialize the clock. Clock interrupts must be handled using the CLSA (6135) instruction.

2. REQUIREMENTS

2.1 Storage

KW12SUBC uses 137 octal or 95 decimal locations.

2.2 Location

The first location of this subroutine package should be assembled into the first location of any 8 mode page with the rest of the program following in successive locations. The subroutine is preset to start in location 6000_8 of bank 0 unless changed by the user.

2.3 Equipment

PDP-12 with KW12A clock option.

3. USAGE

3.1 Calling Sequence

This subroutine has five 8 mode entry points that are indirectly called as follows:

```
JMS I .+1          /Indirect call to KWMEAS
KWMEAS             /whose location is contained
                   /in the location immediately
                   /following the JMS
```

and

```
JMS I TAG          /Indirect call to KWSTOP, KWCONT,
                   /KWREAD or KWINIT whose address
                   /is at "TAG".
```

In using one of the entry points, the subroutine will look for data contained in the third, fourth, and fifth locations following the JMS. In all cases, except when the clock counter is to be read, the AC and link of the main program are preserved.

4. DESCRIPTION

The entry point KWMEASure is used to set up the clock to measure events or intervals of time. The working contents of the clock control register, clock enable register, and the number of counts to overflow are specified in the locations following the JMS, as follows:

```
.       JMS I .+1
.+1     KWMEAS          /JMS to entry point KWMEAS
.+2     C1C2C3C4        /Clock control register setting

.+3     BUFF            /No. of counts to overflow
.+4     E1E2E3E4        /Clock enable register setting

.+5                     /Control returns here
```

The first two octal digits of the control register setting control the rate and mode of the clock, respectively. The last two digits are used to simulate inputs from the external channels. The interpretation of C_1, the rate control, is as follows:

C_1	Rate
Ø	STOP
1	400 KHz
2	100 KHz
3	10 KHz
4	1 KHz
5	100 KHz
6	Count occurrences of events on external channel 1 if E_3=2.

The interpretation of C_2, the mode control, is as follows:

C_2	Mode
Ø	Counter runs at selected rate and overflow is set after 4Ø96 counts. The counter continues to run and the overflow must be cleared by IOT 6135.

C_2	Mode (Cont'd)
1	Counter runs at selected rate. Upon occurrence of overflow caused by the most significant bit of the counter going from a 1 to a Ø, the contents of the buffer preset register is transferred to the counter.
2	Counter runs at selected rate. Upon occurrence of an event on an enabled channel, the contents of the counter are transferred to the buffer preset register and the counter continues to run.
3	Counter runs at selected rate. Upon occurrence of an input event on channel 3, the contents of the counter is transferred to the buffer preset register and the counter is preset to Ø from which it continues counting. Inputs on channels 1 and 2 behave as if C_2=2.
4	The counter runs at the selected rate and overflows every 4Ø96 counts. Upon occurrence of an overflow, an A/D conversion is initiated if the fast sample mode is in use. Overflow must be cleared by the 6135 instruction. Note than when in this mode A/D conversions are inhibited unless a clock overflow occurs.
5	This is treated as the combination of (C_2=4) and (C_2=1).
6	(C_2=4) and (C_2=2).
7	(C_2=4) and (C_2=3).

BUFF is an octal number, 1-7777, and is the number of counts to occur before the counter overflows. The subroutine places the 2's complement of BUFF in the buffer preset register and initially in the counter.

The last 3 digits of the enable register setting are interpreted as follows:

E_2	Function
Ø,2,4,6	No function
1,3,5,7	Causes clock interrupt on counter overflow.

E_3	Function
ø	No Function
1	Enable interrupt on channel 2 if channel 2 input enabled.
2	Enable input on channel 1
3	(E_3=1) and (E_3=2)
4	No Function
5	Same as E_3=1
6	Enable input and interrupt on channel 1
7	(E_3=6) and (E_3=1)

E_4	Function
ø	No Function
1	No Function
2	Enable input channel 3
3	Enable input and interrupt for channel 3
4	Enable input channel 2
5	Same as E_4=4
6	(E_4=4) and (E_4=2)
7	(E_4=4) and (E_4=3)

Upon entering the KW12 setup subroutine package at point KWMEASure, the subroutine retrieves the locations .+2, .+3, and .+4 considering the location (.) to be the locations of the JMS I .+1. The contents of these locations are stored in software created control (KWCONR), enable (KWENAB), and buffer registers (KWBUFF). Then the clock is set up to perform the specified tasks. Control is returned to location .+5 with the AC and link preserved and the clock running.

Other entry points are used as follows:

```
.       JMS I .+1       /Stop the clock but preserve
.+1     KWSTOP          /software control, enable, and
                        /buffer registers.

.+2                     /Control returns here with AC
                        /and link preserved.

.       JMS I .+1       /Restart the clock using the
.+1     KWCONTinue      /settings contained in the
                        /software registers.  Control
.+2                     /returns here with the AC and
                        /link preserved.
```

```
.      JMS I .+1      /Read the clock counter into
.+1    KWREAD         /the AC.  If overflow has oc-
                      /curred, set link = 1, other-
                      /wise link = Ø.  Control
.+2                   /returns here.

                      /In the process of performing
                      /the read, the buffer preset
                      /register is restored to the
                      /contents of KWBUFF.

.      JMS I .+1      /Initializes the clock and
.+1    KWINIT         /clears software control,
                      /enable, and buffer registers.
.+2                   /Control returns to main
                      /program here with AC and
                      /link preserved.
```

5.0 EXAMPLES

The following is a program to ring the Teletype bell one time per second:

```
BEGIN, JMS I .+1     /JMS indirectly to
       KWMEAS        /loc KWMEAS
       51ØØ          /Rate = 1ØØ Hz, Mode = 1
       Ø144          /144 octal or 1ØØ decimal counts
                     /to overflow
       Ø1ØØ          /Interrupt on clock overflow

CHECK, CLSK          /(6131) skip on clock interrupt
       JMP CHECK     /Wait
       CLSA          /Clear Clock Flag (6135)
       CLA           /Clear AC
       TAD K2Ø7      /Load 2Ø7 into AC
       TSF           /Check teletype flag
       JMP .-1
       TLS           /Output AC to teletype
       JMP CHECK     /Go back and wait for next
                     /clock overflow
       K2Ø7, Ø2Ø7    /Symbol definition
                     /Append KW12 setup subroutine
                     /package
```

The following is a program that will ring the teletype bell after counting 6Ø events on external channel 1:

```
BEGIN, JMS I .+1     /JMS indirectly to
       KWMEAS        /location KWMEAS
       61ØØ          /Rate = chan 1, Mode = 1
       ØØ74          /Interrupt after (74)8 or
                     /(6Ø)10 counts
       Ø12Ø          /Enable chan 1 input
                     /interrupt on overflow

CHECK, CLSK          /(6131) skip on clock interrupt
       JMP CHECK     /Wait
       CLSA          /Clear Clock Flag (6135)
       CLA           /Clear AC
       TAD K2Ø7      /Load AC with (2Ø7)8
       TSF           /Test Teletype flag
```

```
JMP .-1         /Wait
TLS             /Ring bell
JMP CHECK       /Jump to wait loop
K2Ø7, Ø2Ø7      /Symbol definition

                /Append KW12 setup subroutine
                /package
```

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DEC-12-ADRMA-A-D

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