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THE PDP-8 COOKBOOK, VOLUME 2

DECUS Program Library Write-up DECUS NO. 8-602B

THIS VOLUME IS ISSUED IN THREE PARTS:

PART 1 CONTAINS A DIRECTORY OF ALL SUBROUTINE NAMES.
A DIRECTORY, SELECTED BY FUNCTIONAL KEYWORDS.
NAMES AND CONTRIBUTIONS OF AUTHORS.
DEFINITIONS OF KEYWORDS IN USE.

PART 2 CONTAINS REVISIONS TO SUBROUTINES IN VOLUME #1.

PART 3 CONTAINS 44 NEW PROGRAM MODULES.

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KEYWORDS, CURRENTLY USED IN THE PDP8 COOKBOOK
==========

FUNCTIONS
==========

ARITHMETIC	= ALL TYPES OF OPERATIONS OF AN ARITHMETIC NATURE (+-*/ETC. BUT ALSO BOOLEAN ALGEBRA)
STRINGS	= USED TO DENOTE ALL TYPES OF OPERATIONS RELATED TO THE ORGANISATION AND STRUCTURE OF DATA. (ALSO: BUFFERS, CONVENTIONAL 'STRINGS' ETC.)
FILE	= OPERATIONS THAT ORGANIZE A DATA STRUCTURE ON A LARGE STORAGE, BACKING UP DEVICE.
SORTING	= USED TO DENOTE THE TYPE OF OPERATIONS WHERE THE COMPARISON OF DATA WITH OTHER DATA IS ESSENTIAL.
CONVERSION	= CONVERSION FROM ONE DATA STRUCTURE OR FORMAT TO ANOTHER.
PROGRAM CONTROL	= DENOTES OPERATIONS THAT ARE USED TO DIRECT THE FLOW OF THE PROGRAM IN THE FIRST INSTANCE.
INPUT	= OPERATIONS THAT INPUT DATA INTO THE COMPUTER.
OUTPUT	= OPERATIONS THAT PUT DATA OUT FROM THE COMPUTER.
INTERRUPT	= DENOTES OPERATIONS WHERE THE INTERRUPT IS USED.
GRAPHICS	= OPERATIONS ON GRAPHICAL DATA, AND DISPLAY
SIGNAL PROCESSING	= OPERATIONS OF A MATHEMATICAL NATURE ON DATA THAT REPRESENT SOME SIGNAL.

DATA FORMATS
==========

BINARY	= THE CONVENTIONAL 'BINARY' FORMAT AS IT IS USED BY LOADERS.
ASCII	= 8 BIT DATA, REPRESENTING ONE CHARACTER FOLLOWING THE USASCII STANDARD
CODE	= A CHARACTER REPRESENTATION FOLLOWING SOME OTHER STANDARD
OCTAL	= ASCII, RESTRICTED TO OCTAL VALUES
DECIMAL	= ASCII, RESTRICTED TO DECIMAL VALUES
HEXADECIMAL	= ASCII, RESTRICTED TO HEXADECIMAL VALUES.
IMAGE	= THE 12 BIT WORD AND SEQUENCES OF PDP8 COMPUTER WORDS.

SYSTEM SOFTWARE RESTRICTIONS
==========

DISKMONITOR	= CONFINED FOR DISK MONITOR USERS
OS8	= CONFINED FOR OS8 USERS
TSS8	= CONFINED FOR TSS8 TIMESHARING USERS

DEVICE TYPE RESTRICTIONS
==========

DISK	= DF32, RF08, RK08 ETC.
DECTAPE	= DIGITAL EQUIPMENT'S MAGNETIC TAPE UNITS
MAGTAPE	= INDUSTRIAL AND OTHER MAGNETIC TAPE DEVICES
DISPLAY	= ALL TYPES OF DISPLAYS, CHARACTER- AND VECTOR TYPES
PAPERTAPE	= PAPERTAPE READERS AND PUNCHES.

001 TYPE THE CHARACTERS FOLLOWING THE JMS INSTRUCTION.
K: STRINGS, OUTPUT, ASCII

002 TELETYPE TYPE ROUTINE WITH OVERLAP; NOT RESTARTABLE.
K: OUTPUT, ASCII, BINARY

003 TYPE A CHARACTER CHAIN
K: OUTPUT, ASCII

004 DECIMAL TO DECIMAL CONVERSION AND TYPE
K: OUTPUT, CONVERSION, BINARY, IMAGE

005 BINARY TO OCTAL CONVERSION AND PRINT
K: OUTPUT, CONVERSION, OCTAL

006 HIGH SPEED READER SUBROUTINE
K: OUTPUT, PAPERTAPE, ASCII, BINARY

007 TABULATOR ROUTINE
K: STRINGS, ASCII, OUTPUT

008 SUBROUTINE TO MOVE A BLOCK THROUGH CORE
K: SORTING, STRINGS, IMAGE

009 BINARY PUNCH WITH FIELD SETTING
K: CONVERSION, IMAGE, BINARY, OUTPUT

010 PAL MESSAGE PRINTER
K: OUTPUT, ASCII, CONVERSION,

011 GENERAL BRANCH ROUTINE
K: PROGRAM CONTROL,

012 CHECK IF OCTAL
K: PROGRAM CONTROL, OCTAL, ASCII

013 LOGICAL OPERATORS ON TWO NUMBERS
K: ARITHMETIC

014 PS8-OS8 OPTION DECODER
K: PROGRAM CONTROL, OS8

015 PRINT TWO DIGITS IN DECIMAL
K: OUTPUT, DECIMAL, CONVERSION

016 PRINT THE PS8-OS8 DATE
K: OUTPUT, OS8, DECIMAL

017 PRINT THE AC AS A FOCAL LINENUMBER
K: OUTPUT, CONVERSION, DECIMAL

018 PRINT 4 DECIMAL DIGITS USING ROUTINE PRNT2
K: OUTPUT, CONVERSION, DECIMAL

019 SUBROUTINE READS A DECIMAL NUMBER FROM KEYBOARD
K: INPUT, CONVERSION, DECIMAL

020 DECIMAL PRINT ROUTINE
K: OUTPUT, CONVERSION, DECIMAL

021 SUBROUTINE TO PRINT DOUBLE LENGTH DECIMAL
K: OUTPUT, CONVERSION, DECIMAL

022 OCTAL PRINT ROUTINE
K: OUTPUT, CONVERSION, OCTAL

023 DOUBLE WORD OCTAL PRINT ROUTINE, USES OCTPRT
K: OUTPUT, CONVERSION, OCTAL

024 SUBROUTINE TRANSLATES TELEX CODE TO ASCII
K: CONVERSION, TELEX, ASCII

025 SUBROUTINE TO TRANSLATE TELEX CODE TO ASCII
K: CONVERSION, ASCII, CODE

026 ROUTINE TO TRANSLATE ASCII TO TELEX CODE
K: CONVERSION, ASCII, CODE

027 INTERRUPT OUTPUT HANDLER WITH ROTATING BUFFER
K: INTERRUPT, STRINGS, OUTPUT, ASCII

028 DEVICE INTERRUPT HANDLER
K: INTERRUPT, STRINGS, OUTPUT, ASCII

029 SUBROUTINE READS OR WRITES DECTAPE IN 2 DIRECTIONS
K: INPUT, OUTPUT, DECTAPE, IMAGE, FILE

030 SUBROUTINE TO PACK CHARACTERS (TSS8)
K: CONVERSION, STRINGS, ASCII, TSS8

031 SUBROUTINE PACKS CHARACTERS ONE BY ONE (TSS8 FORMAT)
K: CONVERSION, STRINGS, ASCII, TSS8

032 SUBROUTINE TO PACK CHARACTERS ONE BY ONE (TSS8 FORMAT)
K: CONVERSION, STRINGS, ASCII, TSS8

033 SUBROUTINE TO UNPACK CHARACTERS (TSS8 FORMAT)
K: CONVERSION, STRINGS, ASCII, TSS8

034 SUBROUTINE UNPACKS CHARACTERS ONE BY ONE (TSS8 FORMAT)
K: CONVERSION, STRINGS, ASCII, TSS8

035 SUBROUTINE TO READ A NAME FROM KEYBOARD (EXCESS 40 CODE)
K: INPUT, CONVERSION, ASCII, STRINGS

036 SUBROUTINE SEARCHES NAME IN DN-BLOCKS (DISKMONITOR)
K: FILE, STRINGS, DISKMONITOR, DECTAPE, DISK

037 SUBROUTINE SEARCHES UNUSED BLOCK ON DISK (DISKMONITOR)
K: FILE, STRINGS, DISKMONITOR, DECTAPE, DISK

038 SUBROUTINE SEARCHES INTERNAL FILE NUMBER (DISKMONITOR)
K: FILE, STRINGS, DISKMONITOR, DECTAPE, DISK

039 SUBROUTINE READS OR WRITES ON DISK (TSS8)
K: FILE, INPUT, OUTPUT, DISK, TSS8

040 SUBROUTINE TO DISPLAY A BLOCK OF DATA ON VC8E
K: CONVERSION, OUTPUT, DISPLAY, STRINGS

041 SUBROUTINE TO DISPLAY INPUT FROM AN ANALOG CHANNEL
K: OUTPUT, CONVERSION, DISPLAY,

042 SUBROUTINE TO INPUT A BLOCK OF DIGITAL DATA (DR8E)
K: INPUT, STRINGS

043 SUBROUTINE TO SMOOTH A BLOCK OF DATA IN MEMORY
K: STRINGS, ARITHMETIC, SIGNAL PROCESSING

044 SUBROUTINE TO REDISTRIBUTE A BLOCK OF DATA
K: STRINGS, ARITHMETIC, SIGNAL PROCESSING

045 PACK A CHARACTER IN A BUFFER IN OS8 FORMAT
K: CONVERSION, STRINGS, ASCII, OS8

046 UNPACK A CHARACTER FROM A BUFFER IN OS8 FORMAT
K: CONVERSION, STRINGS, ASCII, OS8

047 PARITY GENERATOR
K: CONVERSION, ASCII

048 SKIP ON FLAG WITH TIMED OUT RETURN
K: PROGRAM CONTROL, INPUT, OUTPUT

049 SEARCH A LIST FOR A MATCH
K: STRINGS, PROGRAM CONTROL

050 LIST SEARCH, CROSS-FIELD CALLABLE
K: PROGRAM CONTROL, STRINGS

051 RELATIVE BRANCHER, CROSS-FIELD CALLABLE
K: PROGRAM CONTROL,

052 GENERAL SETUP FOR OS8 HANDLERS
K: INPUT, OUTPUT, OS8, ASCII, BINARY

053 UNPACK CHAR-BY-CHAR FOR OS8 HANDLERS
K: INPUT, STRINGS, OUTPUT, CONVERSION, ASCII, BINARY, OS8

054 UNPACK CHAR-BY-CHAR FOR OS8 HANDLERS
K: INPUT, STRINGS, OUTPUT, CONVERSION, ASCII, BINARY, OS8

055 UNPACK AND PRINT OS8 BUFFER (DEVICE HANDLER)
K: OUTPUTSTRINGS, CONVERSION, ASCII, BINARY, OS8

056 PUSH AND POP OPERATORS FOR DIFFERENT STACKS
K: STRINGS, PROGRAM CONTROL

057 FILL A ROTATING BUFFER QUEUE (FIRST IN FIRST OUT)
K: STRINGS

058 RESET (CLEAR) A ROTATING BUFFER QUEUE
K: STRINGS

059 FETCH THE NEXT ITEM FROM THE HEAD OF THE QUEUE
K: STRINGS

060 COMBINED ROTATING BUFFER OPERATORS, CROSS-FIELD CALLABLE
K: STRINGS

061 BINARY LOADER SUBROUTINE
K: INPUT, CONVERSION, BINARY, IMAGE

062 INTERRUPT SERVICE BY LIST-LOOK-UP
K: INTERRUPT, PROGRAM CONTROL, INPUT, OUTPUT

063 FIND THE SMALLEST HOLE IN A LIST, JUST BIG ENOUGH
K: STRINGS, SORTING

064 LINK FOR RELOCATABLE CROSS-PAGE REFERENCING IN ONE FIELD
K: PROGRAM CONTROL

065 INITIALIZE THE FREECORE AREA
K: STRINGS

066 REQUEST A FREE BLOCK
K: STRINGS

067 RELEASE A BLOCK TO FREECORE
K: STRINGS

068 RELEASE A QUEUE OF FORWARD LINKED BLOCKLETS TO FREECORE
K: STRINGS

069 MAKE A BUFFER OR 'QUEUE'
K: STRINGS

070 READ NEXT ELEMENT FROM THE TAIL OF A ROTATING BUFFER (QUEUE)
K: STRINGS

071 WRITE AN ELEMENT ONTO THE TOP OF A BUFFERQUEUE
K: STRINGS

072 KILL THE BUFFER QUEUE
K: STRINGS

073 ROUTINE TO CONVERT OCTAL NUMBERS 0-17 TO EXCESS-40 STRIPPED CODE
K: CONVERSION, OCTAL, CODE

074 INTERRUPT ROUTINE FOR REAL-TIME CLOCK
K: INTERRUPT, CONVERSION

075 PRINT DATE, WEEKDAY AND TIME FROM THE REGISTERS.
K: CONVERSION, DECIMAL

076 SUBROUTINE TO UNPACK TSS8 TIME
K: CONVERSION, DECIMAL, TSS8

077 SUBROUTINE TO UNPACK TSS8 TIME
K: CONVERSION, DECIMAL, TSS8

078 SUBROUTINE TO UNPACK TSS8 DATE.
K: CONVERSION, DECIMAL, TSS8

079 DECIMAL PRINT WITH VARIABLE NUMBER OF DIGITS.
K: OUTPUT, CONVERSION, DECIMAL

080 OCTAL PRINT WITH LEADING SPACES.
K: OUTPUT, CONVERSION, OCTAL

081 DOUBLE WORD OCTAL PRINT ROUTINE
K: OUTPUT, CONVERSION, OCTAL

082 ASCII STRING GENERATOR
K: OUTPUT, ASCII, STRINGS

083 INCREMENT DOUBLE PRECISION COUNTER.
K: ARITHMETIC

ARITHMETIC,

013 LOGICAL OPERATORS ON TWO NUMBERS
043 SUBROUTINE TO SMOOTH A BLOCK OF DATA IN MEMORY
044 SUBROUTINE TO REDISTRIBUTE A BLOCK OF DATA
083 INCREMENT DOUBLE PRECISION COUNTER.

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054 UNPACK CHAR-BY-CHAR FOR OS8 HANDLERS
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062 INTERRUPT SERVICE BY LIST-LOOK-UP

INTERRUPT,

027 INTERRUPT OUTPUT HANDLER WITH ROTATING BUFFER
028 DEVICE INTERRUPT HANDLER
062 INTERRUPT SERVICE BY LIST-LOOK-UP
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050 LIST SEARCH, CROSS-FIELD CALLABLE
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057 FILL A ROTATING BUFFER QUEUE (FIRST IN FIRST OUT)
058 RESET (CLEAR) A ROTATING BUFFER QUEUE
059 FETCH THE NEXT ITEM FROM THE HEAD OF THE QUEUE
060 COMBINED ROTATING BUFFER OPERATORS,CROSS-FIELD CALLABLE
063 FIND THE SMALLEST HOLE IN A LIST,JUST BIG ENOUGH
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068 RELEASE A QUEUE OF FORWARD LINKED BLOCKLETS TO FREECORE
069 MAKE A BUFFER OR 'QUEUE'
070 READ NEXT ELEMENT FROM THE TAIL OF A ROTATING BUFFER (QUEUE)
071 WRITE AN ELEMENT ONTO THE TOP OF A BUFFERQUEUE
072 KILL THE BUFFER QUEUE
082 ASCII STRING GENERATOR
```

REVISIONS TO THE PDP8 COOKBOOK VOLUME 1

****

O10 CAN BE IMPROVED BY CHANGING THE FIRST INSTRUCTION
'CMA' INTO 'CLA CMA'.
THIS ROUTINE IS ,HOWEVER, SUPERCEDED BY O10A.

****

O13 EXCLUSIVE OR ROUTINE CAN BE IMPROVED:

```
        TAD A
        AND B
        CMA IAC
        CLL RAL
        TAD A
        TAD B
```

OR AS FOLLOWS:

```
        TAD A
        AND B
        CLL RAL
        CIA
        TAD A
        TAD B
```

THE NOR ROUTINE CAN BE IMPROVED:

```
        TAD A
        CMA
        AND B
        TAD A
        CMA
```

```
/010A PAL MESSAGE PRINTER (REPLACES # 010)
/PRINTS A MESSAGE CODED WITH THE
/PALD OR PAL8 PSEUDO-OP "TEXT" .
/
/PALD AND PAL8 COMPATIBLE EXCEPT CAR RET & LINEFEED.
/
/CALL: JMS PRMESG
/      MESG
/      RETURN (AC=0)
/
/MESG,   TEXT '/ABC82'   /CODED AS 0102;0370;6200
/
PRMESG, 0
        CLA CMA
        TAD I PRMESG            /SAVE POINTER
        DCA PRMES3
        ISZ PRMESG              /FOR RETURN
PRMES1, CLA CMA
        DCA PRMES4              /UNPACKSWITCH
        ISZ PRMES3              /NEXT WORD
        TAD I PRMES3            /FETCH WORD
        RTR                     /*
        RTR                     /MAY BE CODED 'BSW' FOR 8E
        RTR                     /*
PRMES2, AND C77                 /MASK 6 BITS
        SNA                     /END OF LIST?
        JMP I PRMESG            /YES
        TAD C240                /RECODE
        AND C77                 /CHARACTER TO
        TAD C240                /BE PRINTED
        JMS PRINT               /AND PRINT
        ISZ PRMES4              /TEST L-R SWITCH
        JMP PRMES1              /LEFT
        TAD I PRMES3            /RIGHT
        JMP PRMES2
/
PRMES3, 0                       /POINTER
PRMES4, 0                       /UNPACKSWITCH 0=R;  1=L
/
/GENERAL CONSTANTS
C77,    77
C240,   240
```

```
/012A CHECK IF OCTAL DIGIT (REPLACES # 012)
/ROUTINE CHECKS WHETHER THE AC IS AN OCTAL DIGIT
/
/TAD CHARACTER
/JMS OCTCHK
/NOT OCTAL RETURN
/OCTAL RETURN
/
OCTCHK, 0
        TAD M260
        AND C7770               /OR "AND M10"
        SNA CLA
        ISZ OCTCHK              /RETURN FOR OCTAL DIGIT
        JMP I OCTCHK
/
/GENERAL CONSTANTS
M260,   -260
C7770,  7770

/012B CHECK WHETHER OCTAL OR NOT
/ROUTINE CAN BE MORE PRACTICAL IF 'SZL CLA' BECOMES
/'SZL' OR 'SNL' IN WHICH CASE THE 'OCTALRETURN'
/IS WITH THAT DIGIT IN THE AC.  THE OTHER RETURN IS
/WITH AC=-260

         10
         -270
OCTCHK,  0
         TAD OCTCHK-1
         CLL
         TAD OCTCHK-2
         SZL CLA
         ISZ OCTCHK
         JMP I OCTCHK
```

```
/019A  REV. 9 FEB 1973
/ SUBROUTINE READS A DECIMAL NUMBER FROM KEYBD
/RUBOUT REMOVES NUMBER COMPLETELY
/
/
/CALL    :JMS DECINP
/        RETURN WITH NUMBER BINARY IN AC
/
/
DECINP,0
        CLA
        DCA DECNUM              /CLEAR REGISTER
        JMS READ                /READ CHAR FROM KEYBOARD
        TAD CHAR
        JMS PRINT               /PRINT THAT CHAR
        TAD CHAR                /GET CHARACTER
        TAD M377                /IS IT RUBOUT?
        SNA CLA
        JMP DECINP+1            /YES READ ALL OVER AGAIN
        TAD CHAR                /NO
        TAD M260
        SPA                     /CHAR>=260?
        JMP DECOUT              /NO,CHARACTER IS DELIMETER
        TAD M12                 /YES
        SMA CLA                 /CHAR<272?
        JMP DECOUT              /NO,CHAR IS DELIMETER
        TAD DECNUM              /YES,CHAR IS FIGURE
        CLL RTL                 /NUMB*4
        TAD DECNUM              /NUMB*4+1=NUMB*5
        CLL RAL                 /NUMB*5*2=NUMB*10
        TAD CHAR                /ADD LAST FIGURE
        TAD M260
        DCA DECNUM              /DECIMAL NUMBER
        JMP DECINP+3
/
DECOUT,CLA
        TAD DECNUM
        JMP I DECINP            /EXIT
/
/VARIABLES
/
DECNUM,0
/
/GENERAL CONSTANTS
M12,    -12
M260,   -260
M377,   -377
```

Ø4Ø

```
/SUBROUTINE TO DISPLAY A BLOCK OF DATA
/DISPLAY CONTROL: VC8-E
/CALLING SEQUENCE:
/       JMS DISPLA
/           START ADDRESS OF MEMORY BLOCK MINUS 1
/           MINUS NO OF WORDS (MAX -2[illegible])
/       RETURN      /AC=Ø


IR1=10
        Ø
        7ØØØ
        Ø
DISPLA, Ø
        TAD I DISPLA      /GET START ADDRESS
        DCA IR1
        ISZ DISPLA
        TAD I DISPLA      /GET NO. OF WORDS
        DCA DISPLA-1
        TAD DISPLA-2      /GET LEFT POINT ON DISPLAY
        DCA DISPLA-3
DISNEX, TAD DISPLA-3      /GET X-POINT
        DILX
        CLA
        TAD I IR1         /GET DATA
        DILY
        CLA
        DISD              /WAIT FOR SETTLING
        JMP .-1
        DIXY
        ISZ DISPLA-3      /INCREMENT X-POINT
        NOP
        ISZ DISPLA-1      /INCREMENT COUNT
        JMP DISNEX
        ISZ DISPLA        /SET RETURN ADDRESS
        JMP I DISPLA      /RETURN
```

Ø41

```
/SUBROUTINE TO DISPLAY INPUT FROM AN ANALOG CHANNEL
/INPUT: AD8-E +AM8-E, DISPLAY CONTROL: VC8E
/CALLING SEQUENCE:
/       JMS MULDIS
/           MULTIPLEXER CHANNEL
/       RETURN     /AC=Ø



        Ø
        Ø
        -1777
        7000
MULDIS, Ø
        TAD I MULDIS      /GET CHANNEL
        ADLM
        TAD MULDIS-1      /GET LEFT POINT ON DISPLAY
        DCA MULDIS-4
        TAD MULDIS-2      /GET MINUS NO. OF POINTS
        DCA MULDIS-3
MULNEX, TAD MULDIS-4      /GET X-POINT
        DILX
        CLA
        JMS MULSAM        /GET SAMPLE
        DILY
        CLA
        DISD              /WAIT FOR SETTLING
        JMP .-1
        DIXY
        ISZ MULDIS-4      /INCREMENT X-POINT
        NOP
        ISZ MULDIS-3      /INCREMENT COUNT
        JMP MULNEX        /GO TO NEXT POINT
        ISZ MULDIS        /SET RETURN ADDRESS
        JMP I MULDIS      /RETURN

MULSAM, Ø
        ADST              /START CONVERSION
        ADSK
        JMP .-1           /WAIT FOR CONVERSION DONE
        ADRB              /READ AD BUFFER
        JMP I MULSAM
```

Ø42

```
/SUBROUTINE TO INPUT A BLOCK OF DIGITAL DATA
/INPUT VIA THE DIGITAL I/O DR8-E
/CALLING SEQUENCE:
/       JMS DIGIN
/           START ADDRESS OF MEMORY BLOCK MINUS 1
/           MINUS NO OF WORDS
/       RETURN     /AC=Ø
/START DATA BLOCK:       BIT 10
/WORD COMMAND:           BIT 11
/END DATA BLOCK:         BIT 9


IR1=10
        Ø
DIGIN,  Ø
        TAD I DIGIN      /GET START ADDRESS
        DCA IR1
        ISZ DIGIN
        TAD I DIGIN      /GET NO. OF WORDS
        DCA DIGIN-1
        DBCO             /CLEAR OUTPUT REGISTER
        DBCI             /CLEAR INPUT REGISTER
        CLA CLL IAC RAL  /START DATA BLOCK
        DBSO             /SET OUTPUT REGISTER
        DBCO             /CLEAR OUTPUT REGISTER
        CLA CLL IAC      /WORD COMMAND PULSE
        DBSO
        DBCO
        CLA CLL
        DBSK             /WAIT FOR FLAG
        JMP .-1
        DBRI             /READ INPUT REGISTER
        DBCI             /CLEAR INPUT REGISTER
        DCA I IR1
        ISZ DIGIN-1      /INCREMENT COUNTER
        JMP .-12         /GO TO NEXT WORD
        CLA CLL IAC RTL  /END DATA BLOCK
        DBSO
        DBCO
        CLA CLL
        ISZ DIGIN        /SET RETURN ADDRESS
        JMP I DIGIN      /RETURN
```

Ø43

```
/SUBROUTINE TO SMOOTH A BLOCK OF DATA IN MEMORY
/DATA WILL BE SMOOTHED WITH THE FILTER:
/A(I)= 1/4.A(I-1) +1/2.A(I) +1/4.A(I+1)
/CALLING SEQUENCE:
/       JMS FILTER
/           START ADDRESS OF MEMORY BLOCK
/           MINUS NO OF POINTS
/       RETURN     /AC=Ø
        Ø
        Ø
        Ø
        Ø
        Ø
FILTER, Ø
        TAD I FILTER      /GET START ADDRESS
        DCA FILTER-1      /INPUT POINTER
        ISZ FILTER
        TAD I FILTER      /GET MINUS NO. OF POINTS
        DCA FILTER-2      /POINT COUNT
        TAD FILTER-1
        DCA FILTER-3      /OUTPUT POINTER
        TAD I FILTER-1    /GET FIRST POINT
        DCA FILTER-5      /SAVE IT IN OUT-STORE
FILNEX, TAD I FILTER-1    /GET FIRST POINT
        JMS FILHAL
        JMS FILHAL        /DIVIDE BY 4
        DCA FILTER-4      /SAVE IT IN IN-STORE
        ISZ FILTER-1      /INCREMENT INPUT POINTER
        TAD I FILTER-1    /GET SECOND POINT
        JMS FILHAL        /DIVIDE BY 2
        TAD FILTER-4      /ADD AND
        DCA FILTER-4      / SAVE IT IN IN-STORE
        ISZ FILTER-1      /INCREMENT INPUT POINTER
        TAD I FILTER-1    /GET THIRD POINT
        JMS FILHAL
        JMS FILHAL        /DIVIDE BY 4
        TAD FILTER-4      /ADD AND
        DCA FILTER-4      /SAVE IT IN IN-STORE
        TAD FILTER-5      /GET PREVIOUS RESULT
        DCA I FILTER-3    /PUT IT BACK IN MEMORY
        TAD FILTER-4      /GET CURRENT RESULT
        DCA FILTER-5      /SAVE IT FOR NEXT OUTPUT
        ISZ FILTER-3      /INCREMENT OUTPUT POINTER
        TAD FILTER-1      /GET INPUT POINTER
        CIA               /AND
        CMA               /SUBTRACT ONE
        DCA FILTER-1
        ISZ FILTER-2      /INCREMENT POINT COUNT
        JMP FILNEX        /GO TO NEXT POINT
        ISZ FILTER        /SET RETURN ADDRESS
        JMP I FILTER      /RETURN
```

```
FILHAL, 0
        SPA             /IS IT POSITIVE?
        JMP .+4
        CLL RAR         /YES, DIVIDE POS.
        CLL             /NUMBER BY TWO
        JMP I FILHAL    /AND JMP BACK
        STL             /NO, DIVIDE NEG.
        RAR             /NUMBER BY TWO
        CLL
        JMP I FILHAL    /AND JMP BACK
```

Ø44

```
/SUBROUTINE TO REDISTRIBUTE A BLOCK OF DATA.
/A SIGNAL, CONSISTING OF X SAMPLES IS REDISTRIBUTED
/INTO A SIGNAL CONSISTING OF THE NEAREST LOWER
/2↑N SAMPLES. (MAX 2048)
/END OF SIGNAL CONDITION: 10 SUCCEEDING ZERO'S.

/GENERAL: X POINTS BECOME Y=2↑N POINTS
/                    (X-1)                    (X-1)
/Y(I)=(1-REST OF I.------.CONTENTS OF  I. ----- +
/                    (Y-1)                    (Y-1)
/                    (X-1)                    (X-1)
/(1-(1-REST OF  I.------)).CONTENTS OF (I.------+1)
/                    (Y-1)                    (Y-1)
/THIS OPERATION IS NECESSARY PRIOR TO APPLYING
/A FAST FOURIER TRANSFORM TO A PERIODIC SIGNAL,
/NOT CONSISTING OF 2↑N SAMPLES.

/NECESSARY HARDWARE: KE8-E EXTENDED ARITHMETIC EL.
/CALLING SEQUENCE:
/       JMS REDIST
/           START ADDRESS OF MEMORY BLOCK MINUS 1
/           MINUS NO. OF POINTS OF SIGNAL BUFFER
/       RETURN   /AC=0
IR1=10
REDSTA, 0
REDPOI, 0
RED0,   0
REDM11, -11
REDCNT, 0
REDNO,  0
REDCMP, 0
REDNEW, 0
REDMIN, -1
REDRES, 0
REDLOC, 0
REDPOS, 4000
REDFAC, 0
REDIST, 0
        TAD I REDIST    /GET START ADDRESS
        DCA IR1
        TAD I REDIST
        IAC
        DCA REDSTA
        ISZ REDIST
        TAD I REDIST    /GET - NO. OF POINTS
        DCA REDPOI
        TAD I REDIST
        DCA REDTLR
        ISZ REDIST      /SET RETURN ADDRESS
```

```
REDNUL, TAD I IR1          /GET WORD
        ISZ REDTLR         /INCREMENT WORD COUNT
        SKP
        JMP I REDIST       /RETURN, NO END OF SIGNAL
        SNA                /TEST FOR AC=0
        JMP .+3
        CLA CLL
        JMP .-7            /NO, TAKE NEXT WORD
        TAD IR1            /YES, STORE LOCATION
        DCA RED0           /OF FIRST ZERO
        TAD REDM11
        DCA REDCNT
        TAD I IR1          /ADD NEXT 9 WORDS
        ISZ REDCNT
        JMP .-2
        SZA CLA             /TEST FOR SUM =0
        JMP REDNUL         /NO, GO ON
        TAD REDSTA         /YES AND
        CIA                /CALCULATE
        TAD RED0           /NO. OF POINTS
        DCA REDNO
        CLA CLL CML RAR /MAKE 4000
        DCA REDCMP
        TAD REDNO
        AND REDCMP         /AND WITH 2↑N
        SNA CLA            /TEST FOR NON ZERO
        JMP .+4
        TAD REDCMP         /YES,THIS IS THE
        DCA REDNEW         /NEW NO. OF POINTS
        JMP .+5
        TAD REDCMP         /NO, DIVIDE
        CLL RAR            /BY TWO
        DCA REDCMP
        JMP .-12           /AND GO AGAIN
        CAM
        SWAB
        TAD REDNEW         /GET 2↑N POINTS
        CIA
        DCA REDTLR         /PUT IN COUNTER
        DCA RED0           /CLEAR I
        TAD REDSTA         /GET START ADDRESS
        TAD REDMIN         /SUBTRACT ONE
        DCA IR1
        TAD REDNO          /GET ORIGINAL NO. OF POINTS
        TAD REDMIN         /SUBTRACT ONE
        DCA REDNO          /THIS IS: (X-1)
        TAD REDNEW         /GET NEW NO. OF POINTS
        TAD REDMIN         /SUBTRACT ONE
        DCA REDNEW         /THIS IS: (Y-1)
```

```
REDNEX, TAD REDNO       /GET (X-1)
        MQL
        MUY
        REDØ            /MULTIPLY WITH I
        DVI
        REDNEW          /DIVIDE BY (Y-1)
        DCA REDRES      /SAVE REST
        SWP             /QUOTIENT TO AC
        TAD REDSTA      /GET START ADDRESS
        DCA REDLOC      /SUM IS: LOCATION
        TAD REDNEW      /GET (Y-1)
        MQL
        TAD REDRES      /GET REST
        SAM             /RESULT: (Y-1)-REST
        MQL             /PUT IN MQ
        TAD I REDLOC    /GET CONTENTS OF LOC.
        TAD REDPOS      /MAKE POS.
        DCA REDCMP
        MUY             /MULT. (Y-1)-REST
        REDCMP          /WITH POS. CONTENTS OF LOC.
        DVI             /DIVIDE RESULT
        REDNEW          /BY (Y-1)
        SWP
        DCA REDFAC      /SAVE FIRST FACTOR
        CAM
        ISZ REDLOC      /INCREMENT LOCATION
        TAD REDRES      /GET REST
        MQL
        TAD I REDLOC    /GET CONTENTS OF LOC. +1
        TAD REDPOS      /MAKE POS.
        DCA REDCMP
        MUY             /MULTIPLY REST WITH
        REDCMP          /POS. CONTENTS OF LOC.  +1
        DVI             /DIVIDE BY
        REDNEW          /(Y-1)
        SWP
        TAD REDFAC      /ADD FIRST FACTOR
        TAD REDPOS      /GET RIGHT SIGN
        DCA I IR1       /AND STORE IN MEMORY
        ISZ REDØ        /INCREMENT I
        ISZ REDTLR      /INCREMENT COUNTER
        JMP REDNEX      /NEXT POINT
        TAD REDNEW      /CALCULATE END ADDRESS
        TAD REDSTA      /OF SIGNAL
        DCA IR1
        TAD REDPOI      /GET -NUMBER OF POINTS
        TAD REDNEW      /IN SIGNAL BUFFER
        IAC             /COMPUTE REST NO. OF POINTS
        DCA REDTLR
        DCA I IR1       /CLEAR REST OF BUFFER
        ISZ REDTLR
        JMP .-2
        JMP I REDIST    /RETURN
```

Ø45

```
/       PACK A CHARACTER IN A BUFFER IN OS/8 FORMAT
/       CAN BE USED FOR BUFFERS UP TO 31 PAGES
/               (NOT USING LAST PAGE OF FIELD)
/       PARAMETERS ARE:
/               CURFLD: FIELD OF SUBROUTINE
/               BUFFLD: FIELD OF BUFFER
/               BUFBEG, BUFEND: DEFINE SIZE OF BUFFER
/       CALL:   TAD     CHAR
/               JMS     PACKB
/                       BUFFER FULL RETURN(AC=Ø)
/                       NORMAL RETURN (AC=Ø)

        Ø               /TEMPORARY STORAGE
PACKB,  •-•
        DCA     PACKB-1 /SAVE CHARACTER
        TAD     PACKSW  /TEST PACKSWITCH
        CDF     BUFFLD
        SZA
        JMP     PACKB1  /IF -2
        TAD     PACKB-1 /GET CHARACTER
        DCA I   PACPTR  /INSERT IN BUFFER
        TAD     PACPTR
        CLL RAR         /IS POINTER ODD ?
        SNL CLA         /SKIP IF YES
        JMP     .+4
        CLA CLL CMA RAL /SET PACKSWITCH TO -2
        DCA     PACKSW
        SKP
        ISZ     PACPTR  /INCREMENT POINTER IF EVEN
        JMP     PACKB2  /GO TO EXIT
PACKB1, CLA CLL CMA
        TAD     PACPTR  /DECREMENT POINTER
        DCA     PACPTR
        TAD     PACKB-1 /GET CHARACTER
        RTL
        RTL             /SHIFT 4 POSITIONS TO LEFT
        DCA     PACKB-1 /SAVE TEMPORARY
        TAD     PACKB-1
        AND     C7400   /KILL BITS 4-11
        TAD I   PACPTR
        DCA I   PACPTR  /INSERT IN BUFFER
        ISZ     PACPTR  /INCREMENT ADDRESSPOINTER
        ISZ     PACKSW  /INCREMENT PACKSWITCH
        JMP     PACKB1+3/AGAIN IF PACKSWITCH NONZERO
        TAD     PACEND
        CMA CLL         /TEST FOR BUFFER END
        TAD     PACPTR
        SNL CLA         /SKIP IF FULL
        JMP     PACKB2
        TAD     PACBEG  /INITIALIZE POINTER
        DCA     PACPTR
        SKP
PACKB2, ISZ     PACKB   /NORMAL RETURN
        CDF     CURFLD
        JMP I   PACKB

PACPTR, BUFBEG
PACKSW, Ø
PACBEG, BUFBEG
PACEND, BUFEND
C7400,  7400
```

```
/       UNPACK A CHARACTER FROM A BUFFER IN OS/8 FORMAT
/
/       CAN BE USED FOR BUFFERS UP TO 31 PAGES
/               (NOT USING LAST PAGE OF FIELD)
/
/       PARAMETERS ARE:
/               CURFLD: FIELD OF SUBROUTINE
/               BUFFLD: FIELD OF BUFFER
/               BUFBEG, BUFEND: DEFINE SIZE OF BUFFER
/
/       CALL:   CLA
/               JMS     UNPACK
/                       RETURN; IF LINK=1: BUFFER EMPTY
/                                  IF LINK=0: NORMAL RETURN
/
/       RETURNS WITH CHARACTER IN AC


        0               /TEMPORARY STORAGE
UNPACK, .-.
        TAD     UNPSW   /TEST PACKSWITCH
        CDF     BUFFLD
        SZA CLA
        JMP     UNPAC1  /IF -2
        TAD I   UNPPTR  /GET FROM BUFFER
        AND     C377    /KILL BITS 0-3
        DCA     UNPACK-1/SAVE TEMPORARY
        TAD     UNPPTR  /IS POINTER EVEN ?
        CLL RAR
        SNL CLA         /SKIP IF NO
        JMP     .+4
        CLA CLL CMA RAL /SET PACKSWITCH TO -2
        DCA     UNPSW
        SKP             /NO INCREMENT
        ISZ     UNPPTR
        JMP     UNPAC2  /GO TO EXIT
UNPAC1, DCA     UNPACK-1/MAKE TEMP. LOCATION ZERO
        TAD I   UNPPTR  /GET WORD
        AND     C7400   /KILL BITS 4-11
        TAD     UNPACK-1
        CLL RTR
        RTR
        DCA     UNPACK-1/SAVE TEMPORARY
        CLA CMA
        TAD     UNPPTR  /DECREMENT POINTER
        DCA     UNPPTR
        ISZ     UNPSW   /INCREMENT PACKSWITCH
        JMP     UNPAC1+1/AGAIN IF NONZERO
        CLA CLL CML IAC RAL
        TAD     UNPPTR
        DCA     UNPPTR  /POINTER +3
        TAD     UNPEND  /TEST FOR BUFFER END
        CMA CLL
        TAD     UNPPTR
        SNL CLA         /SKIP IF EMPTY
        JMP     UNPAC2
```

```
        TAD     UNPBEG  /INITIALIZE POINTER
        DCA     UNPPTR
        SKP             /LINK=1
UNPAC2, CLL             /NORMAL RETURN
        TAD     UNPACK-1/GET CHARACTER
        CDF     CURFLD
        JMP I   UNPACK

UNPPTR, BUFBEG
UNPSW,  0
UNPBEG, BUFBEG
UNPEND, BUFEND

C377,   377
C7400,  7400
```

```
/       PARITY GENERATOR                                        Ø47
/
/       GENERATES ODD OR EVEN PARITY BIT (8TH BIT)
/
/       CALL:   TAD     CHAR
/               JMS     PARITY
/                       RETURN (WITH CHARACTER IN AC)

        Ø       /CHARACTER TEMPORARY
        Ø       /PARITY SUM
PARITY, .-.
        AND     C177    /KILL 8TH BIT
        DCA     PARITY-2
        DCA     PARITY-1
        TAD     PARITY-2/GET CHARACTER
PARIT1, CLL RAR
        SZL             /TEST BIT
        ISZ     PARITY-1
        SZA             /NEXT BIT ?
        JMP     PARIT1  /YES
        TAD     PARITY-1/GET PARITY SUM
        RAR
        SZL CLA         /FOR EVEN PARITY;
                        /  IF ODD PARITY: SNL CLA
        TAD     C200    /SET PARITY BIT
        TAD     PARITY-2/GET CHARACTER AND
        JMP I   PARITY  / RETURN

C177,   177
C200,   200
```

```
/       SKIP ON FLAG WITH TIMED OUT RETURN
/
/       CALL:   CLA
/               JMS     SKPOUT
/                       TIME OUT (IN MILLISECONDS)
/                       SKIP INSTRUCTION
/                       TIMED OUT RETURN
/                       NORMAL RETURN


        Ø       /TIMER 1
        Ø       /TIMER 2
        -140    /PRESET TIMER 2 (ADJUST FOR 1 MILLISECOND)
SKPOUT, .-.
        TAD I   SKPOUT  /GET PRESET TIMER 1
        CIA
        DCA     SKPOUT-3
        ISZ     SKPOUT
        TAD I   SKPOUT  /GET SKIP INSTRUCTION
        DCA     SKPOU2
        ISZ     SKPOUT
SKPOU1, TAD     SKPOUT-1
        DCA     SKPOUT-2/SET TIMER 2
SKPOU2, Ø               /OVERLAID BY SKIP INSTRUCTION
        JMP     .+3
        ISZ     SKPOUT  /SKIPPED !
        JMP I   SKPOUT
        ISZ     SKPOUT-2/OVERFLOW TIMER 2 ?
        JMP     SKPOU2  /NO
        ISZ     SKPOUT-3
        JMP     SKPOU1
        JMP I   SKPOUT  /TIMED OUT
```

Ø49

```
/SEARCH A LIST FOR A MATCH
/THE ROUTINE SEARCHES IN A LIST FOR A MATCH WITH AC.
/IT HAS TWO RETURNS :FOUND AND NOT FOUND;
/BOTH WITH AC=Ø. THE LIST TERMINATOR IS ALSO Ø.
/THE FIRST ELEMENT HAS ELEMENTNUMBER Ø

/       TAD (ELEMENT
/       JMS SORTC
/          LIST-1
/         NOT IN LIST RETURN     /AC=Ø
/       NORMAL RETURN            /AC=Ø

/LIST,  301,302,303,304,.......,Ø/ZERO IS TERMINATOR

SORTCN, Ø                  /COUNTER CAN BE ON PAGE Ø
        Ø                  /POINTER
        Ø                  /- AC
SORTC,  .-.                /TEST FOR CHAR. IN LIST
        CIA
        DCA SORTC-1        /SAVE -AC
        DCA SORTCN         /CLEAR COUNTER
        TAD I SORTC        /GET ARG1
        ISZ SORTC          /FOR CORRECT RETURN
        DCA SORTC-2        /SAVE POINTER
        ISZ SORTC-2        /POINTER+1
        TAD I SORTC-2      /GET LIST ELEMENT
        ISZ SORTCN
        SNA                /ZERO?
        JMP I SORTC        /YES, ELEMENT NOT FOUND
        TAD SORTC-1        /COMPARE
        SZA CLA            /EQUAL?
        JMP .-7            /NO,TRY NEXT ELEMENT
        ISZ SORTC          /YES,SET UP RETURN
        JMP I SORTC        /AC=Ø
```

Ø5Ø

```
/LIST SEARCH, CROSS FIELD CALLABLE
/THE ROUTINE MATCHES THE AC AGAINST ALL ELEMENTS
/OF A LIST. IN CASE OF A MATCH IT TAKES THE NORMAL
/RETURN WITH THE OFFSET IN THE LIST IN THE AC.
/IN CASE IT ENCOUNTERS A ØØØØ IN THE LIST, IT
/TAKES THE ERROR RETURN, ALSO WITH OFFSET IN AC.
/THE LIST IS ASSUMED TO BE IN FIELD OF CALL.
/IN THE EXAMPLE: ELEMENT 3Ø1 HAS OFFSET Ø

/       TAD (AC
/       CIF Ø
/       JMS LIST
/          LST-.          /MARK THIS CONSTRUCTION!!!
/          NOT IN LIST RETURN    /AC=OFFSET IN LIST
/       NORMAL RETURN(FOUND)     /AC=OFFSET IN LIST

/LST,   3Ø1;3Ø2;3Ø3;3Ø4;Ø        /ZERO IS TERMINATOR!!!

        Ø                 /OFFSET COUNTER
        Ø                 /POINTER
        Ø                 /-AC

LIST,   Ø
        CIA
        DCA LIST-1
        CMA               /NOTE! COUNTER OVERFLOWS INSTANTLY
        DCA LIST-3        /CLEAR OFFSET COUNTER
        TAD I LIST        /MAKE ARG ABSOLUTE
        TAD LIST
        DCA LIST-2
        ISZ LIST          /FOR RETURN
LIST1,  ISZ LIST-3
        ISZ LIST-2
        TAD I LIST-2
        SNA               /ZERO?
        JMP LISTR
        TAD LIST-1
        SZA CLA           /MATCH FOUND?
        JMP LIST1         /N
        ISZ LIST
LISTR,  RDF
        TAD C6203
        DCA .+2
        TAD LIST-3
        Ø
        JMP I LIST
```

Ø51

```
/RELATIVE BRANCHER;CROSS FIELD CALLABLE
/THIS BRANCH ROUTINE CAN BE CALLED FROM ANY FIELD.
/IT ASSUMES THE LIST IN THE FIELD OF CALL,AND THE
/DESTINATION ADDRESSES TOO. IT WORKS WITH RELATIVE
/DISTANCES AND IS THEREFORE USEFUL FOR RUNTIME RELO-
/CATABLE PROGRAMS.

/       TAD (AC
/       CIF Ø               /IF BRANCH RESIDES IN FIELD Ø
/CALL,  JMS I (BRANCH
/          LIST-.-1         /RELATIVE DISTANCE TO LIST
/       NOT IN LIST RETURN       /AC=Ø

/LIST,  215;CR-.
/       212;LF-.
/       377;RUB-.
/       Ø                   /ZERO IS TERMINATOR !!!!

        Ø                   /TEMP AC;NEGATIVE
        Ø                   /POINTER
BRANCH, .-.                 /ENTER WITH AC=ELEMENT
        CIA
        DCA BRANCH-2
        TAD I BRANCH
        TAD BRANCH          /MAKE POINTER ABSOLUTE
        DCA BRANCH-1
        ISZ BRANCH          /FOR RETURN
BRAN1,  ISZ BRANCH-1
        TAD I BRANCH-1      /FETCH ELEMENT
        SNA                 /IS IT Ø?(END OF LIST)
        JMP BRANR           /Y
        TAD BRANCH-2
        ISZ BRANCH-1
        SZA CLA             /MATCH?
        JMP BRAN1           /N,LOOP
        TAD I BRANCH-1      /PICK DISTANCE TO DESTINATION
        TAD BRANCH-1        /MAKE ABSOLUTE
        DCA BRANCH
BRANR,  RDF                 /FIX FIELD AGAIN, AND JUMP
        TAD C62Ø3
        DCA .+1
          Ø
        JMP I BRANCH
C62Ø3,  62Ø3
```

Ø52

```
/GENERAL SETUP FOR OS8 HANDLERS
/ENTER WITH LINK=1 FOR READ ONLY DEVICE
/LINK =Ø FOR WRITE ONLY DEVICE
/ONLY APPLIES TO NON-BLOCK-ORIENTED DEVICES.
/IT CREATES A WORDCOUNT(WC) SET TO -WORDCOUNT-1
/AND A START ADDRESS OF BUFFER (CA),
/AND A CDF TO THE BUFFER FIELD IN 'SETCDF'.
/'ENTRY' IS THE ENTRYPOINT OF THE HANDLER.
/IT LEAVES THE SUBROUTINE WITH 'ENTRY' POINTING
/TO 'STARTING BLK #' FOR BLOCK ORIENTED DEVICES,
/AND DATAFIELD STILL SET TO FIELD OF CALL.

        7700
        70

TEM=.
SETUP,  Ø
        RDF             /SET UP RETURN
        TAD C6203
        DCA XIT+2
        TAD I ENTRY
        AND SETUP-1     /70
        TAD SETCD       /MAKE CDF
        DCA SETCDF      /FIELD OF BUFFER
        RAR             /GET LINK
        TAD I ENTRY     /GET FUNCTION WORD
        ISZ ENTRY
        SPA             /CHECK READ/WRITE
        JMP ERR         /UNRECOVERABLE ERROR
        AND SETUP-2     /7700
        CLL CML CMA RAL /MAKE -WORDCOUNT-1
        DCA WC
        TAD I ENTRY
        ISZ ENTRY
        DCA CA          /CURRENT ADDRESS
        JMP I SETUP

ERR,    CLA CLL CML RAR /SIGNAL "PERMANENT IO ERROR"
XIT,    ISZ ENTRY
        ISZ ENTRY
          Ø             /CDF CIF
        JMP I ENTRY

SETCD,  CDF Ø           /SOMEWHERE IN HANDLER
C6203,  CDF CIF Ø
CA,     Ø
WC,     Ø
```

Ø53

```
/UNPACK CHAR BY CHAR ROUTINE FOR OS8 HANDLERS.
/NEEDS A WORDCOUNT SET TO -WORDCOUNT-1,AND A POINTER
/SET TO CURRENT ADDRESS (BEGIN OF BUFFER).
/AT THE VERY FIRST ENTRY:PACKSWITCH SHOULD BE Ø.
/THE WORDCOUNT IS INCREMENTED EVERY 3 CHARACTERS.
/IF THE BUFFER IS EXHAUSTED, THE ROUTINE JUMPS TO XIT.
/IT EXITS WITH THE DATAFIELD STILL SET TO THE
/FIELD OF BUFFER

PACKSW, Ø                   /PACKSWITCH.POS. MEANS L.S. 8 BITS
                            /NEG. MEANS MOST SIGN 4 AND 4 BITS.
        7400
        377

UNPACK, .-.                 /ENTER WITH AC=Ø
SETCDF,  Ø                  /SET TO CDF X BY SETUP ROUTINE
        TAD PACKSW
        SPA
        JMP UNP1
        SZA
        CLA CLL CMA RTL     /AC=-3
        DCA PACKSW
        ISZ PACKSW          /PACKSW IS -2 ØR +1
        TAD I CA            /FETCH LS 8 BITS
        AND UNPACK-1
        ISZ CA              /FOR NEXT
        ISZ WC
        JMP I UNPACK        /EXIT WITH NEXT CHAR IN AC
C7600,  7600                /CLA
        DCA PACKSW          /RESET PACKSWITCH FOR NEXT ENTRY
        JMP XIT

UNP1,   TAD CA              /SET POINTER BACK
        DCA CA
        CLL
        DCA TEM
        TAD I CA
        AND UNPACK-2
        TAD TEM
        RTL
        RTL
        ISZ CA
        ISZ PACKSW          /LOOP 2 TIMES;ALSO SETS PACKSW=Ø
        JMP UNP1+3
        RAL
        JMP I UNPACK

CA,     Ø
WC,     Ø
TEM,    Ø                   /TEMP. LOCATION,SOMEWHERE IN HANDLER
```

Ø54

```
/UNPACK CHAR BY CHAR FOR OS8 HANDLERS.
/ROUTINE UNPACKS AN OS8 FORMAT ASCII BUFFER CHARACTER
/BY CHARACTER. IT NEEDS A POINTER (CA) SET TO THE
/BEGINNING OF THE BUFFER, AND A WORDOUNT (WC) SET
/TO - THE NUMBER OF WORDS IN THE BUFFER -1.
/THE LOCATION 'SETCDF' NEEDS TO BE SET TO THE FIELD
/WHERE THE BUFFER RESIDES.
/THE PACKSWITCH HAS 3 VALUES:Ø FOR THE FIRST OF 3 CHARS.
/1 FOR THE SECOND, AND 2 FOR THE 3RD.
/THE PACKSWITCH SHOULD BE Ø WHEN ENTERED FOR THE FIRST
/TIME. THE ROUTINE LEAVES THE DATAFIELD TO THE FIELD
/OF BUFFER UPON EXIT. IF BUF EMPTY THEN JUMP TO 'XIT'.

PACKSW, Ø                   /Ø,1, OR 2
        7400
        377

UNPACK, ..-.                /ENTER WITH AC=Ø
SETCDF,    CDF              /OVERLAID
        TAD PACKSW
        RAR
        SZL                 /1?
        JMP UNP2            /Y
        SZA CLA
        JMP UNP3            /2
UNP1,   TAD I CA
        AND UNPACK-2
        CLL RTR
        DCA TEM             /BYTE 3 ALREADY PARTLY PREPARED
        TAD I CA
        AND UNPACK-1
        ISZ CA
        ISZ PACKSW
        ISZ WC              /INCR. TWICE, EVERY 3 BYTES
        JMP I UNPACK
C7600,  7600                /CLA
        JMP XIT

UNP2,   TAD I CA
        AND UNPACK-2        /PREPARE  3RD BYTE
        CLL RTR
        RTR
        RTR
        TAD TEM
        JMP UNP1+2

UNP3,   DCA PACKSW          /PREPARE FOR NEXT ENTRY
        TAD TEM
        JMP I UNPACK

TEM,    Ø                   /SOMEWHERE IN THE HANDLER
CA,     Ø
WC,     Ø
```

Ø55

```
/UNPACK AND PRINT OS8 BUFFER; IN HANDLER
/THIS PROGRAM PART IS USEFUL FOR HANDLERS THAT HAVE
/AN OUTPUT ROUTINE THAT LEAVES BITS Ø-3 AS THEY
/ARE. THE WORDCOUNT (WC) SHOULD BE SET TO -WORDCOUNT/2
/AS IT INCREMENTS EVERY 2 LOCATIONS (3 BYTES).
/THE ROUTINE IS ENTERED AND EXITED WITH THE DATAFIELD
/SET TO THE FIELD OF BUFFER.

UNP,    TAD I CA        /FIRST BYTE
        ISZ CA
        JMS OUTPUT
        AND C7400Ø
        DCA TEM
        TAD I CA        /2ND BYTE
        ISZ CA
        JMS OUTPUT
        AND C7400Ø      /3RD BYTE
        CLL RTR
        RTR
        TAD TEM
        RTR
        RTR
        JMS OUTPUT
C7600,  7600Ø
        ISZ WC
        JMP UNP
        JMP XIT

TEM,    Ø               /SOMEWHERE IN HANDLER
CA,     Ø
WC,     Ø
C7400,  7400Ø
```

```
/PUSH AND POP OPERATORS
/THE ROUTINES CAN OPERATE ON DIFFERENT STACKS
/WHICH ARE POINTED TO BY THE ARGUMENT.
/CONVENTION IS THAT THE POINTER ALWAYS POINTS TO
/AN ELEMENT, UNLESS COUNT=Ø, THEN IT POINTS TO
/ITSELF.
/
/       TAD (AC
/       JMS PUSH
/         STACK
/       FULL RETURN, AC=Ø
/       NORMAL RETURN,AC=Ø

/STACK,-21      /-MAX SIZE OF STACK=21(8)
/       Ø       /COUNTER OF ELEMENTS;Ø=EMPTY
/       .       /POINTER, SET TO CURRENT LOC.
/       1       /FIRST ELEMENT
/       2;3;4.........Ø (LAST ELEMENT)

        Ø               /TEMP. POINTER
PUSH,   .-.
        DCA POPTEM      /SHARED LOCATION
        TAD I PUSH      /SAVE PTR
        ISZ PUSH
        DCA PUSH-1
        TAD I PUSH-1    /STACK FULL?
        ISZ PUSH-1
        TAD I PUSH-1
        SMA CLA
        JMP I PUSH      /YES, FULL RETURN
        ISZ I PUSH-1    /COUNT+1
        ISZ PUSH-1
        ISZ I PUSH-1    /POINTER+1
        TAD I PUSH-1
        DCA PUSH-1      /POINTER FETCHED
        TAD POPTEM      /DEPOSIT IN STACK
        DCA I PUSH-1
        ISZ PUSH
        JMP I PUSH
```

Ø56
(CONTINUED)

```
/THE POP OPERATION FETCHES ONE WORD FROM THE
/STACK.

/       JMS POP
/          STACK          /POINTS TO STACK
/       EMPTY RETURN      /AC=Ø
/       NORMAL RETURN     /AC=ELEMENT

POPTEM, Ø
        7777
        Ø                 /TEMP.POINTER
POP,    .-.
        TAD I POP
        DCA POP-1         /SET UP PTR TO STACK
        ISZ POP
        ISZ POP-1
        TAD I POP-1       /COUNT=Ø?BUF EMPTY?
        SNA SPA
        JMP I POP         /YES, EMPTY RET.
        TAD POP-2         /DECREMENT COUNT
        DCA I POP-1
        ISZ POP-1         /POINTS TO PTR
        TAD I POP-1
        DCA PUSH-1
        TAD I PUSH-1      /FETCH ELEMENT
        DCA POPTEM
        TAD PUSH-1        /DECREMENT PTR
        TAD POP-2
        DCA I POP-1
        TAD POPTEM        /EXIT WITH ELEMENT IN AC
        ISZ POP
        JMP I POP
```

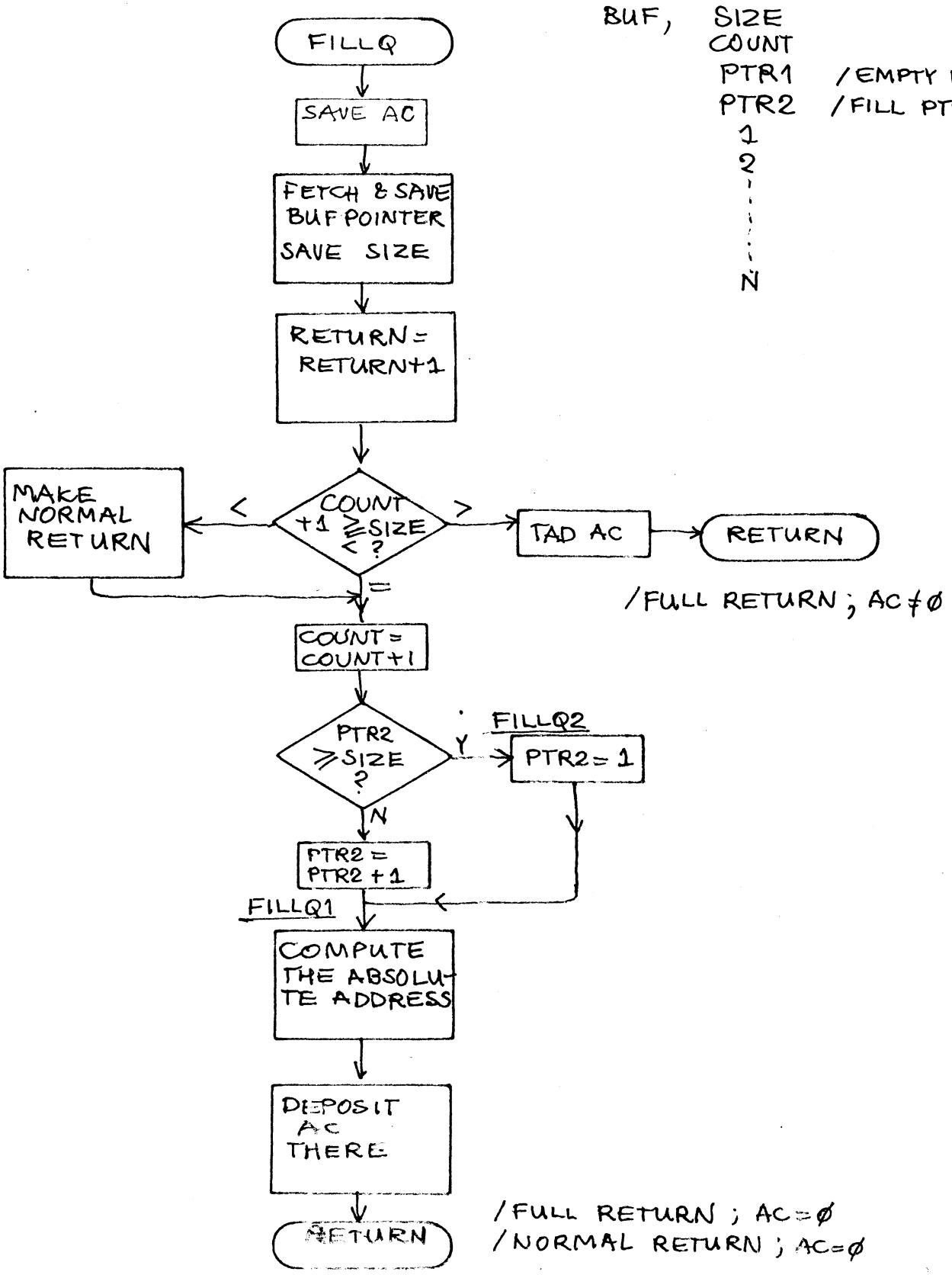
```
/FILL A ROTATING BUFFER QUEUE
/FILLQ IS A ROUTINE THAT PUTS THE AC IN THE NEXT
/FREE LOC.IN THE BUFFER.  THE CONCEPT IS THAT THE ROU-
/TINE CAN BE USED FOR VARIOUS BUFFERS. EACH BUFFER
/CARRIES ITS OWN ADMINISTRATION DATA.

/       JMS FILLQ
/          BUF            /ARG POINTS TO BUF BOOKKEEPER.
/          FULL RETURN    /AC=0 IF ELEMENT STILL ACCEPTED
/                         /AC UNEQ 0 IF NOT ACCEPTED
/       NORMAL RETURN     /AC=0

        0                 /SAVE SIZE
        0                 /POINTER IN BUFBOOKKEEPER
        0                 /SAVE AC
FILLQ,  .-.               /ENTER WITH THE ELEMENT IN THE AC
        DCA FILLQ-1       /SAVE AC
        TAD I FILLQ       /ARGUM. POINTS TO BUF
        ISZ FILLQ         /FOR RETURN
        DCA FILLQ-2
        TAD I FILLQ-2     /SAVE SIZE
        DCA FILLQ-3
        ISZ FILLQ-2
        TAD FILLQ-3       /AC=-SIZE+COUNT+1
        CIA
        TAD I FILLQ-2
        IAC
        SMA SZA
        JMP FILLQ3        /BUF FULL, AC NOT ACCEPTED
        SZA CLA
        ISZ FILLQ         /FOR NORMAL RETURN
        ISZ I FILLQ-2     /COUNT+1
        ISZ FILLQ-2
        ISZ FILLQ-2       /FOR PTR2
        ISZ I FILLQ-2     /PTR2+1
        TAD FILLQ-3       /-SIZE+PTR2>=0?
        CIA
        TAD I FILLQ-2
        SMA SZA CLA
        JMP FILLQ2        /NO, WRAP AROUND
FILLQ1, TAD I FILLQ-2     /YES, COMPUTE REAL ADDR
        TAD FILLQ-2       /PTR2+'PTR2'
        DCA FILLQ-3
        TAD FILLQ-1
        DCA I FILLQ-3     /DEP IN BUF
        JMP I FILLQ
FILLQ2, IAC
        DCA I FILLQ-2
        JMP FILLQ1        /PTR2=1
FILLQ3, CLA
        TAD FILLQ-1
        JMP I FILLQ
```

FILL A ROTATING BUFFER Q

Ø57



Ø58

```
/RESET A ROTATING BUFFER QUEUE
/CLEAR THE BUFFER BY SETTING COUNT=Ø, AND MOVING POINTERS
/TO THEIR INITIAL POSITION.(SYMMETRICALLY)

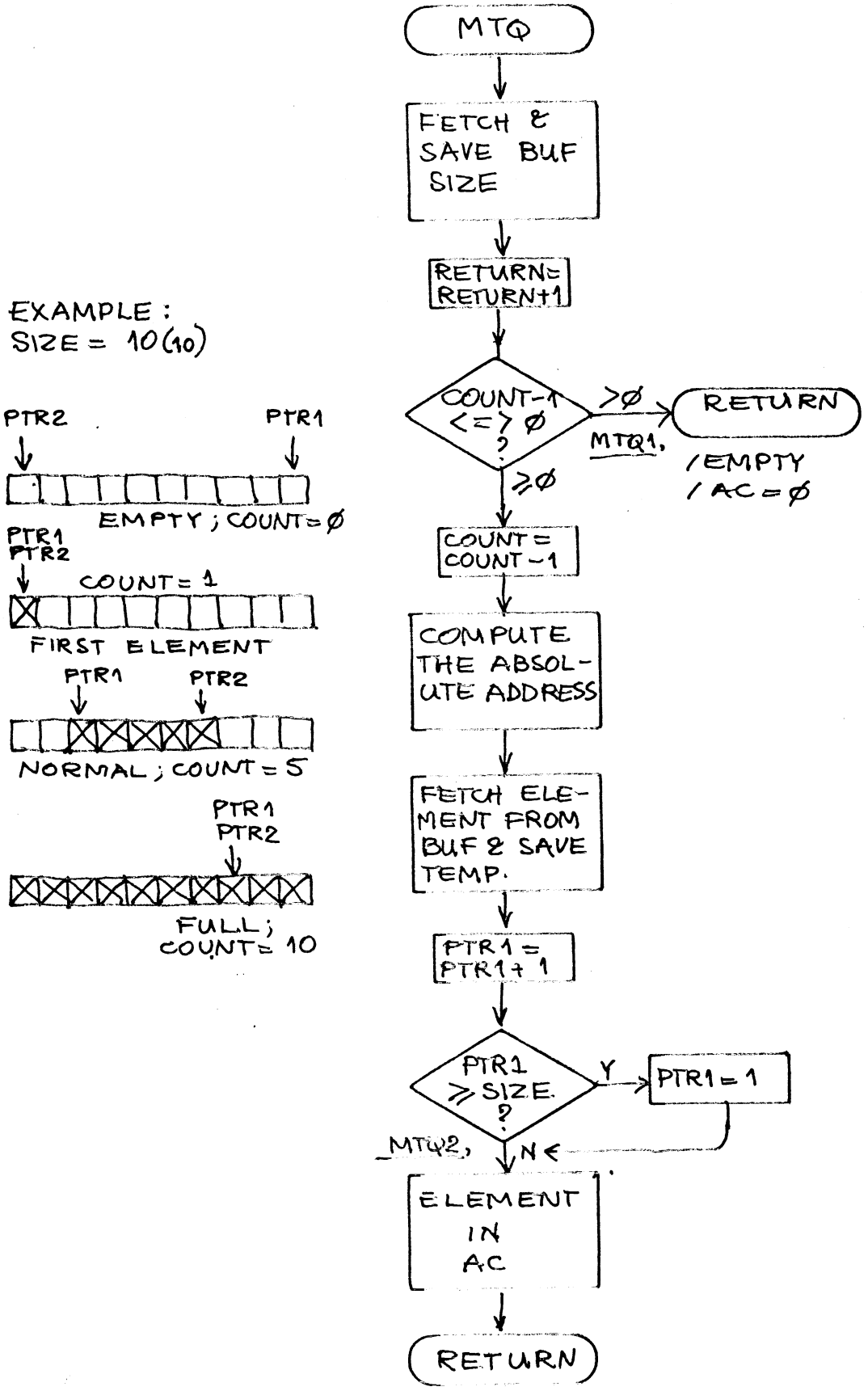
/BUF,   16          /MAX. SIZE OF BUFFER;SPECIFIED HERE
/       Ø           /COUNTS # OF ELEMENTS IN BUF
/       1           /EMPTY POINTER(PTR1) SET TO FIRST ITEM
/       16          /FILL POINTER(PTR2) SET TO END OF BUF
/       ZBLOCK 16           /THE ACTUAL BUFFER AREA

        Ø                   /SAVE SIZE
        Ø                   /BUFPTR
CLRQ,   •-•                 /ENTER WITH AC=Ø
        TAD I CLRQ          /GET POINTER TO BUFBOOKKEEPER
        DCA CLRQ-1
        ISZ CLRQ            /FOR RETURN
        TAD I CLRQ-1        /SAVE SIZE
        DCA CLRQ-2
        ISZ CLRQ-1          /FOR COUNT=Ø
        DCA I CLRQ-1
        ISZ CLRQ-1
        IAC                 /PTR1=1
        DCA I CLRQ-1
        ISZ CLRQ-1
        TAD CLRQ-2
        DCA I CLRQ-1        /PTR2=SIZE
        JMP I CLRQ
```

```
/FETCH THE NEXT ITEM FROM THE HEAD OF THE Q.
/       JMS MTQ
/          BUF              /POINTER TO BUFFER
/       EMPTY RETURN        /AC=Ø
/       NORMAL RETURN       /AC=ELEMENT
/MTQ STANDS FOR EMPTY-THE QUEUE

        Ø                   /SAVE ELEMENT
        Ø                   /BUF SIZE
        Ø                   /POINTER IN BUFBOOKKEEPER
MTQ,    •-•                 /ENTER WITH AC=Ø
        TAD I MTQ           /PTR TO BUFBOOKKEEPER
        DCA MTQ-1
        TAD I MTQ-1         /SAVE SIZE
        DCA MTQ-2
        ISZ MTQ             /FOR RETURN
        ISZ MTQ-1
        CMA
        TAD I MTQ-1         /COUNT-1<Ø?
        SPA
        JMP MTQ1            /YES,BUF EMPTY
        DCA I MTQ-1         /COUNT=COUNT-1
        ISZ MTQ-1
        IAC                 /COMPUTE REAL ADDRESS
        TAD I MTQ-1         /PTR1+'PTR1'+1
        TAD MTQ-1
        DCA MTQ-3           /SAVE
        TAD I MTQ-3         /FETCH THE ELEMENT
        DCA MTQ-3           /SAVE
        ISZ I MTQ-1         /PTR1=PTR1+1
        TAD I MTQ-1         /-PTR1+SIZE<Ø?
        CIA
        TAD MTQ-2
        SMA CLA
        JMP MTQ2            /YES,UPDATE PTR1
        IAC
        DCA I MTQ-1         /PTR1=1
MTQ2,   TAD MTQ-3           /ELEMENT IN AC
        ISZ MTQ
        JMP I MTQ
MTQ1,   CLA
        JMP I MTQ           /'EMPTY' RETURN
```

EMPTY A ROTATING BUFFER QUEUE ØSG



```
/COMBINED ROTATING BUFFER OPERATORS, CROSS FIELD CALLABLE.      Ø6Ø
/TWO SUBROUTINES HAVE BEEN PUT TOGETHER IN ORDER TO
/SAVE SPACE. FILLQ PUTS AN ELEMENT INTO THE BUFFER,
/AND MTQ TAKES ONE FROM THE BUFFER. EACH BUFFER HAS ITS
/OWN ADMINISTRATION, WHICH MAKES THE ROUTINES USEFUL FOR
/MULTIPLE BUFFERS WITH EACH ITS OWN LENGTH AND CONTENTS.
/WHEN USING THE ROUTINE CROSS FIELD IT ASSUMES THE BUFFER
/IN THE FIELD OF CALL. THE ARGUMENT IS RELATIVE, SO THE
/ROUTINES CAN BE USED IN A RELOCATABLE ENVIRONMENT.
/POINTERS ARE ALSO RELATIVE.

/THIS IS WHAT THE BUFFER LOOKS LIKE:
/BUF,   16      /MAX. SIZE OF BUF. HERE THE BUF IS 16 LONG
/       Ø       /COUNTER OF ELEMENTS IN THE BUFFER
/       Ø       /'READ' POINTER, USED BY MTQ
/       Ø       /'WRITE' POINTER, USED BY FILLQ
/       ZBLOCK 16       /THE ACTUAL BUFFER AREA
/NOTE THAT THE BUFFER SHOULD BE SET UP AS ABOVE.

/       TAD ELEMENT
/       CIF MONFLD
/       JMS I (FILLQ
/          BUF-.
/         BUFFER FULL RETURN/AC=Ø MEANS THAT THE ELEMENT
/                         /HAS BEEN ACCEPTED (THE VERY LAST ONE)
/                         /AC=ELEMENT MEANS NOT ACCEPTED!
/       NORMAL RETURN     /AC=Ø

QSIZE,  Ø       /SIZE OF BUF SAVED HERE
QPTR,   Ø       /POINTER IN ADMINISTRATION OF BUFFER.
C6203,  6203

FILLQ,  .-.
        JMS SETFIL      /INITIAL SETUP, COMMON FOR BOTH.
        TAD I QPTR      /BUFFER FULL?
        CMA
        TAD QSIZE       /SIZE-COUNT-1
        SPA
        JMP FILLQR-1    /BUF FULL;AC NOT ACCEPTED
        SZA CLA
        ISZ FILLQ       /BUF OK;NORMAL RETURN
        ISZ I QPTR      /COUNT+1
        ISZ QPTR
        JMS QWRAP       /INCREMENT POINTER AND/OR WRAP
        TAD QAC         /DEPOSIT
        DCA I QPTR
        CLA
FILLQR,   Ø
        JMP I FILLQ
```

```
SETFIL, .-.             /COMMON SETUP
        DCA QAC
        TAD I FILLQ     /GET ARGUMENT
        TAD FILLQ       /MAKE ABSOLUTE
        DCA QPTR
        TAD I QPTR      /SAVE SIZE
        DCA QSIZE
        RDF             /FOR RETURN
        TAD C6203
        DCA FILLQR
        ISZ QPTR        /-> COUNT
        ISZ FILLQ       /-> ERROR RETURN
        JMP I SETFIL

/INCREMENT POINTER, AND TEST FOR END OF BUFFER.
/ELSE WRAP-AROUND. RETURN WITH QPTR POINTING TO THE ABSOLUTE
/BUFFER LOCATION

QWRAP,  .-.
        ISZ QPTR        /ALSO COMMON INSTRUCTION
        ISZ I QPTR      /TRY NEXT LOC. IN BUF
        TAD QSIZE       /BEYOND SIZE?
        CIA
        TAD I QPTR
        SMA CLA
        DCA I QPTR      /WRAPS AROUND
QWR1,   TAD I QPTR      /COMPUTE ABSOLUTE ADDRESS
        TAD QPTR
        IAC
        DCA QPTR
        JMP I QWRAP

/FETCH THE NEXT ITEM FROM THE ROTATING BUFFER
/       CIF MONFLD
/       JMS I (MTQ
/          BUF-.
/         EMPTY RETURN  /AC=0
/       NORMAL RETURN   /AC=ELEMENT

QAC=.           /TO SAVE SPACE
MTQ,    .-.
        TAD MTQ
        DCA FILLQ
        JMS SETFIL      /DO COMMON SETUP
        CMA
        TAD I QPTR      /COUNT-1<0?
        SPA
        JMP FILLQR-1    /Y, BUF EMPTY
        ISZ FILLQ       /FOR NORMAL RETURN
        DCA I QPTR      /N, CONFIRM
        JMS QWRAP       /INC POINTER ETC.
        ISZ QPTR        /READ POINTER COMES EARLIER.
        TAD I QPTR      /FETCH
        JMP FILLQR
```

Ø61

```
/BINARY LOADER SUBROUTINE
/THIS BINARY LOADER IS MUCH DIFFERENT FROM THE STANDARD
/ONE . IT WAS DESIGNED ON THE CONCEPT OF A MECHANISM
/THAT FREES THE PROGRAMMER FROM THE CUMBERSOME BINARY
/FORMAT PECULIARITIES.THE PROGRAM READS BINARY 'TAPE'
/FROM AN INPUT DEVICE AND PRODUCES 3 PARAMETERS OF
/INTEREST:THE LOAD POINTER 'BINPC', THE LOAD FIELD 'BINFLD'
/AND THE CONTENTS OF THE DATA 'BINAC'. THE USER CAN
/TEST FORMATS AND BOUNDARIES, AND HAS TO DEPOSIT THE
/DATA HIMSELF.
/DURING LEADER PHASE THE ROUTINE IGNORES BOTH LEADER
/AND BLANK CODE. A JMS TO BINL WITH AC UNEQ Ø ALSO
/RESETS ALL PARAMETERS AND RETURNS TO LEADER MODE.

/THE BINARY FORMAT TAPE HAS 3 PHASES:
/PHASE 1 (LEADER PHASE) CODES 200 OR 000
/PHASE 2 (ORIGINS,DATA AND FIELD SETTINGS)
/       3X0      /FIELD SETTING TO FIELD X;ADDS NOT TO CHECKSUM
/       2XX;ØYY  /ORIGIN SETTING TO PC=XXYY; ADDS TO CHECKSUM
/       ØXX;ØYY  /DATA ELEMENTS XXYY;ADD TO CHECKSUM
/       ØXX;ØYY  /CHECKSUM XXYY,RIGHT BEFOR THE STOP SIGN
/PHASE 3 (THE STOP SIGN) IS ALSO ONE 200 CODE

/HOW TO USE THE ROUTINE AS A STANDARD BINARY LOADER
/START, JMS BINL
/          HLT   /EOT RETURN;AC=Ø
/          HLT   /READY RETURN;AC=DIFFERENCE IN CHECKSUMS
/       TAD BINFLD      /AC=Ø;NORMAL RETURN
/       DCA TEM
/       TAD BINAC
/TEM,   Ø
/       DCA I BINPC
/       JMP START

        -100
        -300     /CONSTANTS
        6201
        -200
BINC,   77       /MASK
BINPH,  Ø        /PHASE FLAG.Ø=LEADER.POS=ORIGIN;NEG=DATA
BINPC,  Ø        /LOAD POINTER
BINAC,  Ø        /DATA TO BE DEPOSITED IN LOADPOINT
BINFLD, Ø        /FIELD INTO WHICH TO LOAD
CHKSUM, Ø        /COMPUTED CHECKSUM
CHKTEM, Ø        /CHECKSUM OVER 2 FRAMES
        Ø        /FRAME 2
        Ø        /FRAME 1

BINL,   .-.              /AC UNEQ TO Ø RESET ALL PARAMETERS
        SZA CLA
        JMP BIN3
BIN2,   TAD BINPH        /ARE WE IN LEADER PHASE?
        SNA CLA
        JMP BIN3         /Y
```

```
BIN4,    TAD BINL-1          /N, IS FRAME1=FIELD?
         TAD BINC-3          /-300
         SMA CLA
         JMP BIN6            /Y,SET FIELD
         TAD BINL-1          /IF 100-177 MAKE PHASE GT 0
         TAD BINC-4          /IF 000-077 MAKE PHASE NEG
         SMA
         IAC                 /TO AVOID AC=0
         DCA BINPH

/ASSEMBLE 6 M.S.BITS IN BINAC AND MAKE TEMP.CHECKSUM
         TAD BINL-1
         AND BINC
         CLL RTL
         RTL
         RTL
         DCA BINAC
         TAD BINL-1          /MAKE TEMP CHKSUM
         DCA CHKTEM

/READ FRAME 2
         JMS HSREAD
            JMP BINRET+1     /EOT RETURN
         DCA BINL-2
/ASSEMBLE 6 L.S. BITS AND UPDATE TEMP.CHECKSUM
         TAD BINL-2
         AND BINC
         TAD BINAC
         DCA BINAC
         TAD BINL-2          /TEMP CHKSUM
         TAD CHKTEM
         DCA CHKTEM
         TAD BINPH           /ARE WE IN ORIGIN PHASE?
         SMA CLA
         JMP BIN7            /Y;PROCESS ORIGIN SETTING

/READ FRAME 1 IN ADVANCE; THIS IS FOR DATA ONLY
         JMS HSREAD
            JMP BINRET+1     /EOT RETURN
         DCA BINL-1
         TAD BINL-1
         TAD BINC-1          /IS IT 200 CODE?(STOP COE)
         SNA CLA
         JMP BIN8            /Y,END OF DATA
         ISZ BINPC           /NEXT LOCATION
         NOP                 /JUST IN CASE
         TAD CHKTEM          /UPDATE CHKSUM
         TAD CHKSUM
         DCA CHKSUM
         ISZ BINL
BINRET,  ISZ BINL
         JMP I BINL
```

```
/RESET ALL PARAMETERS FOR START OF NEW DATATAPE
BIN3,    TAD BINC-2        /CDF Ø
         DCA BINFLD
         DCA CHKSUM        /CHKSUM=Ø
         DCA BINPH         /SET TO LEADER PHASE

BIN5,    JMS HSREAD        /READ 1 FRAME
            JMP BINRET     /EOT RETURN
         DCA BINL-1
         TAD BINL-1        /IS IT LEADER CODE?
         TAD BINC-1
         SNA CLA
         JMP BIN2          /Y,PROCEED LEADER LOOP
         TAD BINL-1        /IS IT ØØØ?
         SNA CLA
         JMP BIN2          /Y,IGNORE ALSO IF IN LEADER MODE
         JMP BIN4          /N,CAN BE ORIGIN ONLY

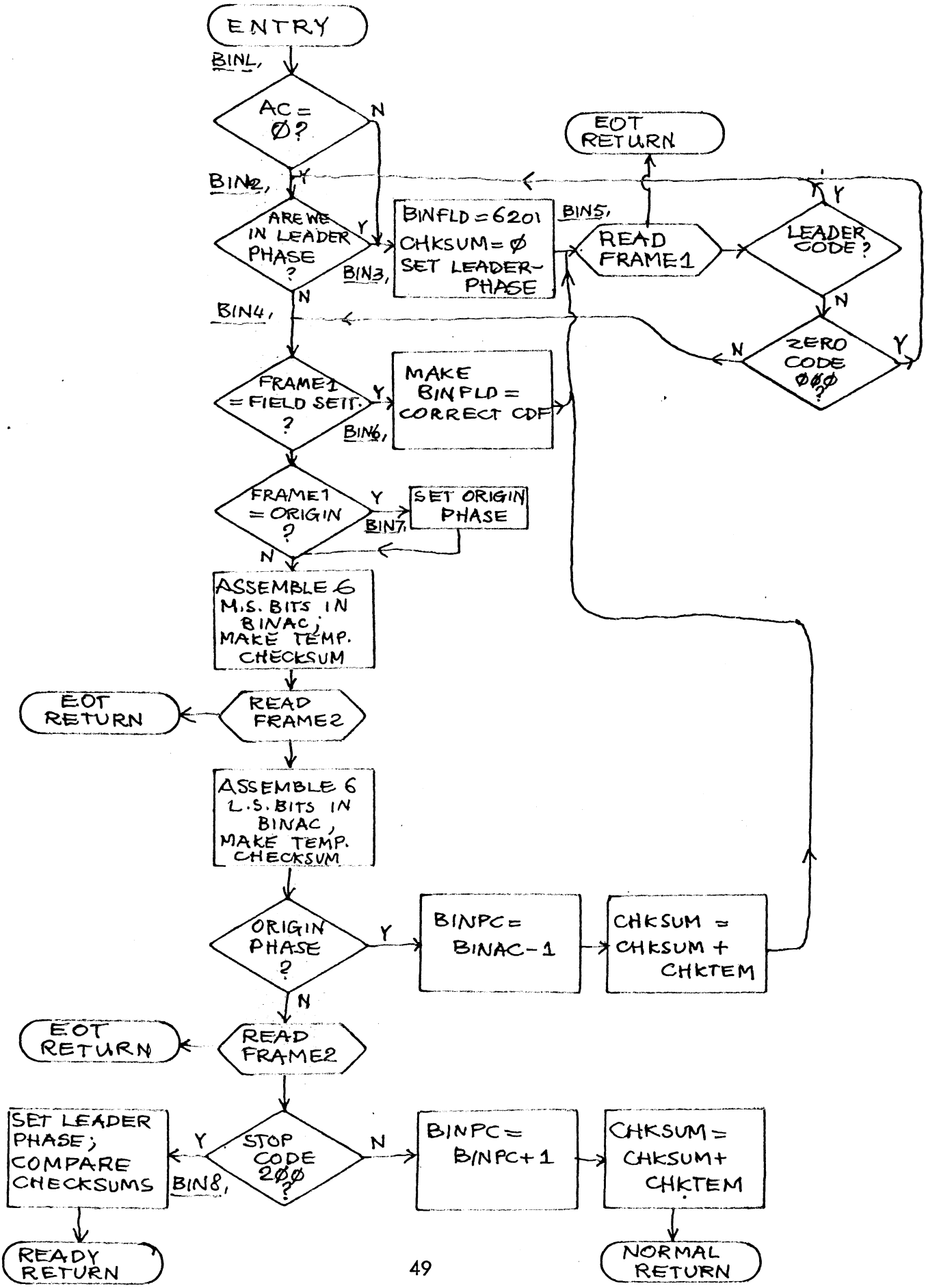
/MAKE CDF OUT OF FRAME 1
BIN6,    TAD BINL-1
         AND BINC
         TAD BINC-2        /AC=ØXØ
         DCA BINFLD
         JMP BIN5

/PROCESS ORIGIN SETTING AND LOOK FOR MORE
BIN7,    CMA               /PC-1
         TAD BINAC         /THIS IS NEW PC
         DCA BINPC
         TAD CHKTEM
         TAD CHKSUM        /UPDATE CHKSUM
         DCA CHKSUM
         JMP BIN5

/END OF DATA PROCESSING;COMPARE TWO CHECKSUMS
BIN8,    DCA BINPH         /SET TO LEADER PHASE
         TAD BINAC         /TAPE CHKSUM
         CIA
         TAD CHKSUM
         JMP BINRET        /END OF DATA RETURN(READY)
```

BINARY LOADER SUBROUTINE

Ø61



Ø62

```
/INTERRUPT SERVICE BY LIST LOOK-UP
/THE ROUTINE TRIES TO IDENTIFY THE INTERRUPTING
/DEVICE BY LOOKING IN THE SKIP LIST. IF FOUND, IT
/CLEARS THE HARDWARE FLAG WITH THE INSTRUCTION
/IN THE CLEARLIST. THEN IT JUMPS TO THE LOCATION
/POINTED TO IN THE JUMP LIST.
/IT TAKES CARE FOR SPECIAL DEVICES THAT SKIP IF THE
/FLAG WAS LOW INSTEAD OF HIGH, AS IS NORMALLY THE CASE.
/THIS IS NECESSARY FOR THE KV8 INTERRUPTBAR.(6051)
/FOR THIS PURPOSE LEAVE OUT BIT 4000(2051) IN SKIPLST.
/SKIP LIST ALWAYS TERMINATED BY A ZERO!!!!
/OTHER LISTS NOT.

/SKPLST,        6031;6041;2051;6141;6151;0
/CLRLST,        6032;6042;6052;6142;6152
/JMPLST,        KBD1;TTY;INTBAR;KBD2;TTY2
/
/*0      JMP I .+1;INTSERV

INTAC,  0               /AC SAVED HERE
INTLNK, 0               /LINK SAVED HERE
INTPTR, 0               /POINTER IN LISTS
        4000
        SKPLST-1
        CLRLST-SKPLST   /USED TO FIND LIST
        JMPLST-CLRLST   /TO FIND JUMPLIST

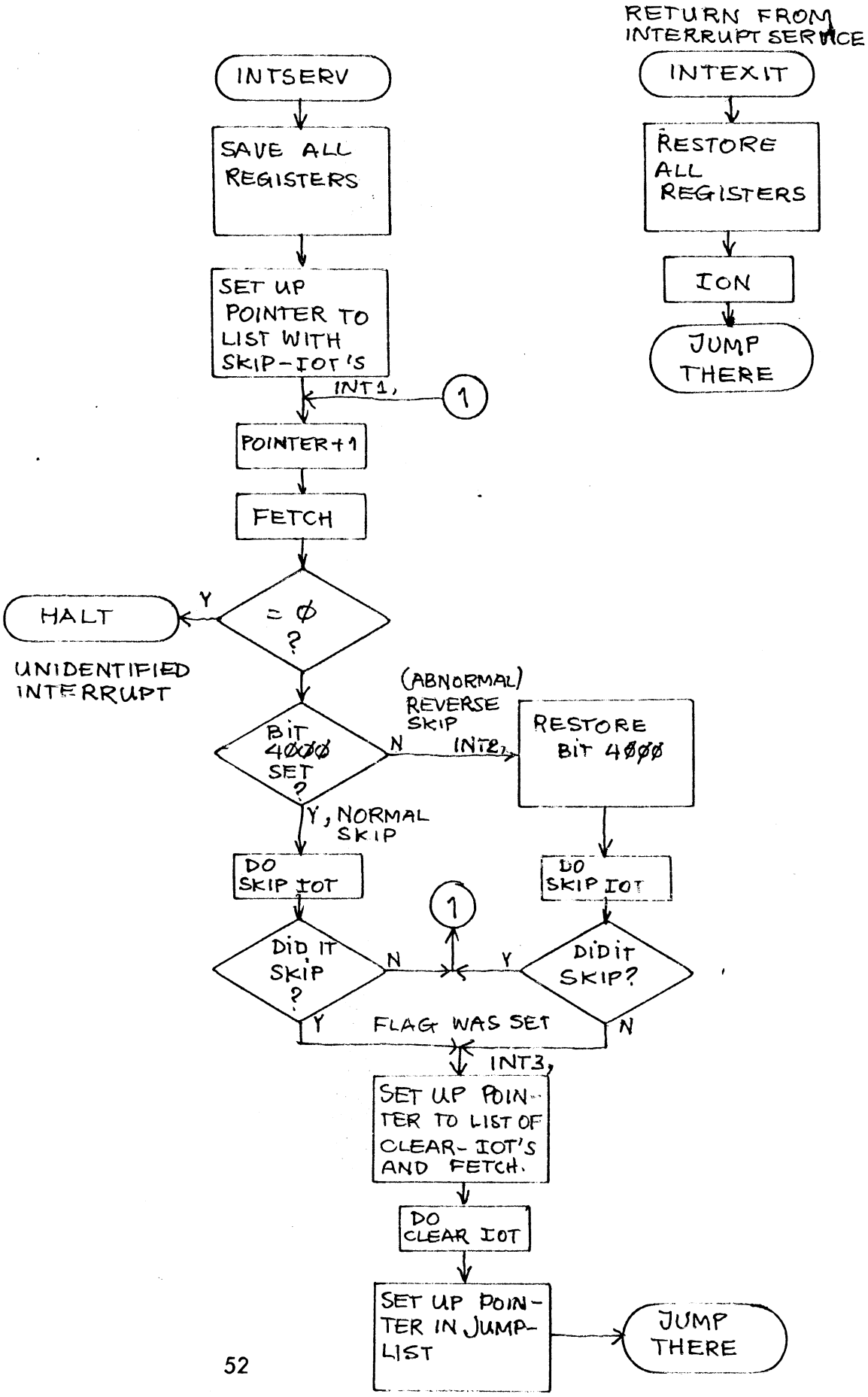
INTSERV,DCA INTAC       /SAVE AC AND LINK
        RAL
        DCA INTLNK
        TAD INTSER-3    /SET UP POINTER
        DCA INTPTR
INT1,   CLA             /JUST IN CASE
        ISZ INTPTR
        TAD I INTPTR    /GET SKIP INSTR.
        SMA             /STRANGE SKIP?
        JMP INT2        /YES, BIT 4000 WAS LEFT OUT
        DCA .+1
           0            /OVERLAID BY SKIP INSTR.
        JMP INT1        /DID NOT SKIP
INT3,   TAD INTPTR
        TAD INTSER-2    /WHERE IS CLEAR INSTR?
        DCA INTPTR
        TAD I INTPTR    /PICK IT UP
        DCA .+1
           0            /OVERLAID BY CLEAR INSTR.
        TAD INTPTR      /WHERE TO GO?
        TAD INTSER-1
        DCA INTPTR
        TAD I INTPTR
        DCA INTPTR
        JMP I INTPTR    /JUMP THERE
```

```
INT2,   SNA                 /END OF LIST?
        HLT                 /HALT IF INTERRUPT NOT FOUND
        TAD INTSER-4        /SET BIT 4000
        DCA .+1
           Ø                /OVERLAID BY SKIPINSTR.
        JMP INT3
        JMP INT1

EXIT,   CLA CLL             /JUST IN CASE
        TAD INTLNK
        CLL RAR
        TAD INTAC
        RMF
        ION
        JMP I Ø
```

GENERAL INTERRUPT BRANCHER

Ø62



Ø63

```
/FIND SMALLEST HOLE IN A LIST,JUST BIG ENOUGH.
/THE ROUTINE FINDS A HOLE IN A LIST THAT MATCHES
/A SPECIFIED SIZE (IN THE AC) BEST. IT RETURNS
/WITH THE POINTER TO THAT HOLE IN THE AC.

/       TAD (4          /SEARCH SMALLEST HOLE > OR = 4LOC.
/       JMS SMALL
/          LISTBEGIN
/          -LISTEND
/       NOT FOUND RETURN        /AC=Ø
/       NORMAL RETURN   /AC=POINTER TO HOLE BEGIN

/LISTBEGIN,     1;3;2;4;Ø;Ø;Ø;Ø;Ø
/LISTEND,       Ø
/ZEROES REPRESENT HOLES!!!!!

        7777            /ENDSWITCH:Ø=END;7777=NORMAL
SMALCN, Ø               /COUNTS SIZE OF HOLE
        Ø               /POINTS WHERE LAST HOLE WAS
        Ø               /HOLEFLAG:Ø=HOLE;7777=NOT HOLE
        Ø               /POINTER IN LIST
        Ø               /SIZE OF LAST HOLE
        Ø               /-SIZE OF HOLE WANTED.

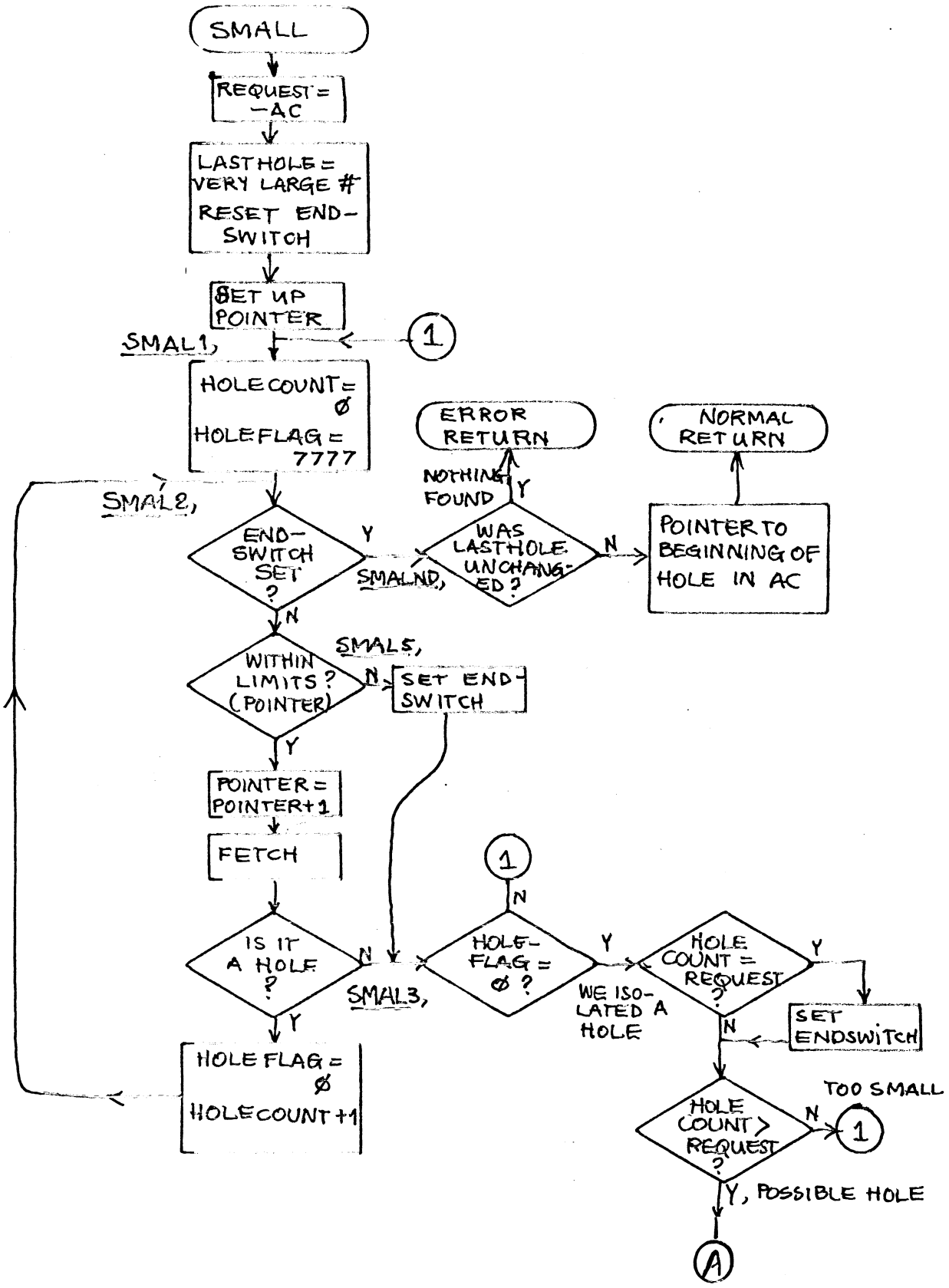
SMALL,  .-.             /ENTRY,SIZE OF WANTED HOLE IN AC
        CIA
        DCA  SMALL-1    /SAVE -SIZE
        CMA             /SET LAST HOLE SIZE TO LARGE VALUE
        DCA  SMALL-2
        CMA             /RESET END SWITCH
        DCA  SMALCN-1
        CMA
        TAD I SMALL     /SET UP POINTER (-1)
        DCA  SMALL-3
        ISZ  SMALL      /POINTS TO -LISTEND)
SMAL1,  DCA  SMALCN     /CLEAR HOLE COUNTER
        CMA             /SET HOLEFLAG TO NOT HOLE
SMAL2,  DCA  SMALL-4
        TAD  SMALCN-1   /END SWITCH SET?
        SNA CLA
        JMP  SMALND     /YES,REAL END
        TAD  SMALL-3    /OUT OF LIST?
        CLL
        TAD I SMALL
        SZL CLA
        JMP  SMAL5      /YES, SIGNAL END FOR NEXT TURN
        ISZ  SMALL-3    /POINTER+1
        TAD I SMALL-3   /FETCH
/THE FOLLOWING INSTRUCTION DETERMINES WHAT IS A HOLE
/AND WHAT NOT. IN THIS CASE : ØØØØ='HOLE'
        SZA CLA         /IS IT A ZERO?
        JMP  SMAL3      /NO
        DCA  SMALL-4    /CLEAR HOLEFLAG
        ISZ  SMALCN     /COUNT SIZE OF HOLE
        JMP  SMAL2      /SET HOLEFLAG AND PROCEED
```

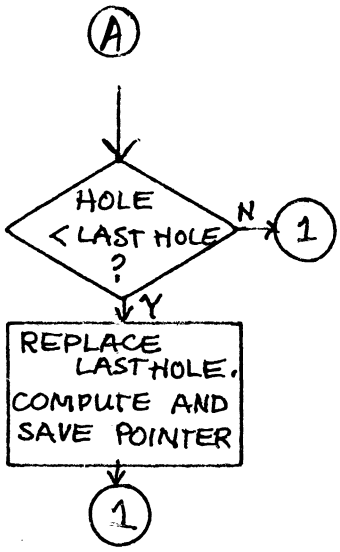
```
/WE HAVE NOW TOUCHED AN OCCUPIED LOCATION. IF THIS
/WAS THE FIRST AFTER A SET OF ZEROES, IT TERMINATES
/A HOLE. LISTEND ALSO TERNINATES A HOLE!!(ENDFLAG)
SMAL3,  TAD SMALL-4      /HOLEFLAG=Ø?
        SZA CLA
        JMP SMAL1        /NO, WE ARE STILL IN OCC. AREA
        TAD SMALCN       /YES, WE JUST ISOLATED A HOLE
        TAD SMALL-1      /IS HOLE EXACTLY WHAT WE WANT?
        SNA
        DCA SMALCN-1     /SET END FLAG
        SPA CLA
        JMP SMAL1        /NO, TOO SMALL, SEARCH FURTHER
        TAD SMALL-2      /YES, FOUND A POSSIBLE HOLE
        CIA CLL          /IS IT SMALLER THAN LAST HOLE?
        TAD SMALCN
        SZL CLA
        JMP SMAL1        /NO, LAST HOLE IS BETTER MATCH
        TAD SMALCN       /YES, REPLACE LAST HOLE
        DCA SMALL-2
        TAD SMALL-2      /MAKE IT POINT TO HOLEBEGIN
        CIA
        TAD SMALL-3      /ALSO REMEMBER WHERE LAST HOLE BEGINS
        DCA SMALL-5
        JMP SMAL1

/END OF LIST DETECTED, MAY TERMINATE A SET OF ZEROES (HOLE)
/SO SET FLAG TO SIGNAL THAT THE GAME IS OVER, BUT PROCESS
/THE HOLE FIRST.
SMAL5,  DCA SMALCN-1     /SET END FLAG
        JMP SMAL3

/END OF THE ROUTINE. THERE IS EITHER A HOLE OR NO
/HOLE FOUND(LASTHOLE IS STILL 7777)
SMALND, TAD SMALL-2      /LASTHOLE=7777?
        CMA
        SNA CLA
        JMP SMAL4+1      /YES, NOTHING FOUND
        TAD SMALL-5      /TAKE POINTER IN AC
SMAL4,  ISZ SMALL
        ISZ SMALL
        JMP I SMALL
```

FIND THE SMALLEST HOLE IN A LIST, GREATER THAN OR EQUAL TO THE VALUE IN THE AC.




A
HOLE
< LAST HOLE
?
N
1
Y
REPLACE
LAST HOLE.
COMPUTE AND
SAVE POINTER
1

Ø64

```
/LINK FOR RELOCATABLE CROSS-PAGE REFERENCING; WITHIN 1 FIELD.
/THIS LINK WORKS IN MUCH THE SAME WAY AS A DEBUGGING TRACER.
/IT EXECUTES THE INSTRUCTION WITH A COMPUTED OPERAND.
/THE ROUTINE HAS BEEN TAILORED FOR AND, TAD, ISZ, DCA,
/JMP AND JMS. THE LINK WILL BE PRESERVED AND OPERATED
/UPON IN THE NORMAL WAY. IN CASE OF A JMS THE ABSOLUTE
/RETURN ADDRESS IS DEPOSITED IN THE SUBROUTINE ENTRY,
/SO THAT THE RETURN FROM THE SUBROUTINE IS THROUGH A
/JMP I SUBR.ENTRY.   ARGUMENTS ARE PICKED UP IN THE SAME WAY:
/TAD I SUBR.ENTRY.

/       TAD AC
/       JMS LINK          /LINK PREFERABLY IN PAGE Ø
/          B-.            /RELATIVE POINTER
/          TAD            /OR AND, ISZ, DCA, JMP, JMS
/       RETURN
/       RETURN IF ISZ SKIPPED

        1ØØØ              /CONSTANT
        AND I LINKPC      /TO MAKE REAL INSTRUCTION FROM
LINKPC, Ø                 /COMPUTED ABSOLUTE ADDRESS
LINKAC, Ø                 /SAVED AC

LINK,   .-.
        DCA LINKAC
        TAD I LINK        /COMPUTE OPERAND(PC)
        SPA               /TO PRESERVE THE LINK
        CML
        TAD LINK          /MAKE ABSOLUTE ADDRESS
        DCA LINKPC
        ISZ LINK
        TAD I LINK        /AND, TAD...ETC
        ISZ LINK
        SPA
        JMP LINKJ         /JMP OR JMS
        TAD LINKPC-1      /MAKE TAD I LINK INSTR ETC.
        DCA .+2
        TAD LINKAC
           Ø              /OVERLAID
        JMP I LINK        /NORMAL RETURN
        ISZ LINK          /IF IT SKIPPED, RETURN+1
        JMP I LINK

LINKJ,  AND LINKPC-2      /AND (1ØØØ
        SZA CLA           /IS IT JMP OR JMS?
        JMP LINK3         /JMP
        TAD LINK          /DEP. 'RETURN' IN SUBR. ENTRY
        DCA I LINKPC
        ISZ LINKPC        /JUMP TO SUBR.ENTRY+1
LINK3,  TAD LINKAC
        JMP I LINKPC
```

DYNAMIC CORE STORAGE ALLOCATION

Ø65 - Ø72

****

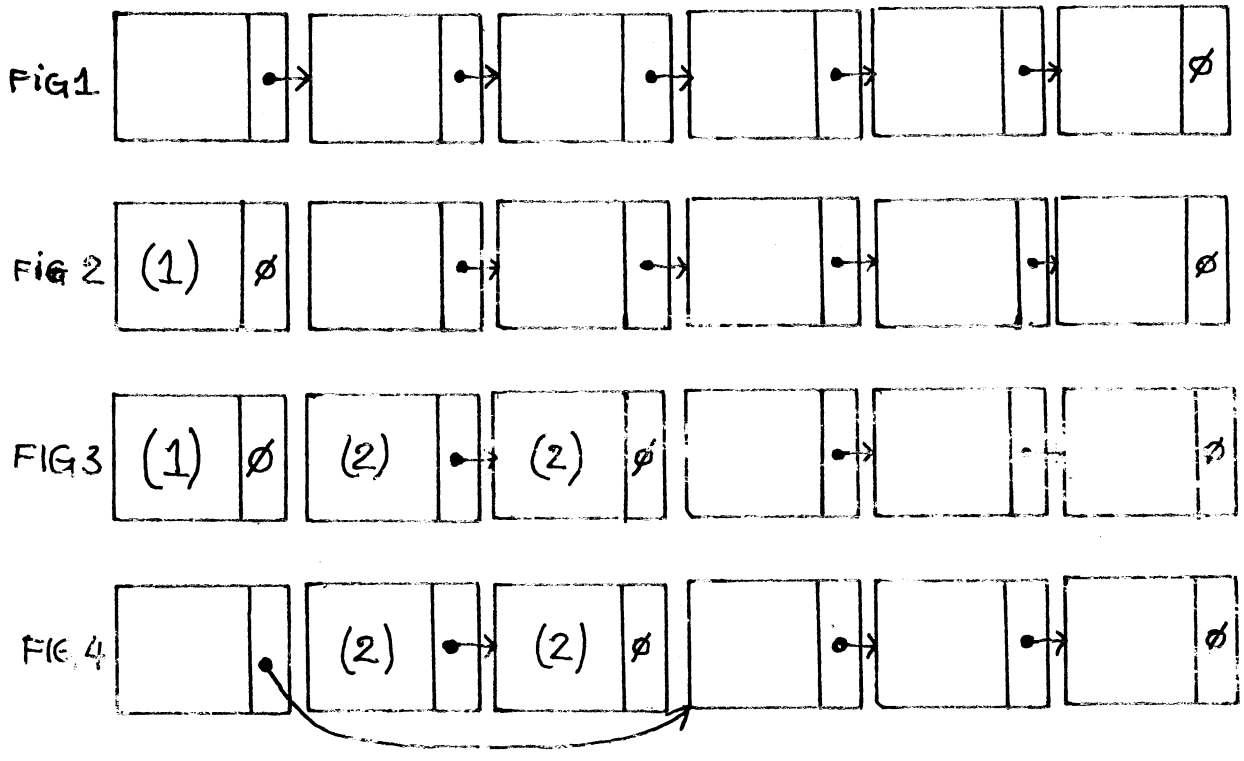
ONE OF THE METHODS TO ALLOCATE CORE STORAGE DYNAMICALLY IS BY USING THE 'FREE-CORE' TECHNIQUE. FREE-CORE IS AN AREA IN CORE, DIVIDED INTO BLOCKLETS OF A GIVEN SIZE. (ALSO EQUAL IN SIZE) THESE BLOCKLETS CONTAIN ONE POINTER POINTING TO THE FOLLOWING BLOCKLET, IN THIS WAY LINKING THE BLOCKLETS IN ONE DIRECTION. (FIG 1)

IF A PROGRAM (1) REQUIRES CORE STORAGE FOR VARIABLES, DATA, OR PUSH-DOWN LISTS, THE NECESSARY STORAGE CAN BE REQUESTED FROM FREECORE IN UNITS OF A GIVEN SIZE. (ONE BLOCKLET AT A TIME). (FIG 2)

IF, FOR EXAMPLE, A DIFFERENT PART OF THE PROGRAM REQUIRES 2 BLOCKLETS, THE FREECORE AREA CAN BE AS IN FIGURE 3.

IF PROGRAM (1) NO LONGER NEEDS ITS BLOCKLET, IT CAN RELEASE THAT BLOCKLET TO FREECORE, WHICH RESTORES THE CHAIN AS IN FIGURE 4.

THE ROUTINES DESCRIBED IN THE FOLLOWING PAGES MAKE USE OF A FREE-CORE AREA CONTAINING BLOCKLETS OF 8 COMPUTER WORDS, THE LAST WORD IN EACH BLOCKLET IS RESERVED FOR THE POINTER.



```
/INITIALIZE THE FREECORE AREA                                    Ø65
/IT ACTS AS IF ALL THE BLOCKS WERE OCCUPIED BY
/SOME STRANGE CHAIN. BY RELEASING THE BLOCKS ONE
/AFTER ANOTHER, THEY BECOME CHAINED TO THE FREE-
/CORE CHAIN OF AVAILABLE BLOCKS.FC ZEROED FIRST.
/FREELO AND FREEHI DELIMIT THIS ACTION.
/
/       CLA
/       JMS INITFC
/          NORMAL RETURN

        Ø                   /TEMP. STORAGE
INITFC, ..-.
        DCA FREEF           /NO FREEBLKS AVAILABLE
        DCA FREECT
        TAD FREEHI          /GET UPPER LIMIT OF FREECORE
        DCA INITFC-1
/
AGAIN,  TAD INITFC-1                /RELEASE ALL BLOCKS
        JMS RELBLK                  /AND CHAIN ALL TOGETHER
        TAD INITFC-1
        TAD C7770           /SET UP FOR NEXT BLOCK
        DCA INITFC-1
/
        TAD FREELO          /GET LOWER LIMIT OF FREECORE
        CIA
        TAD INITFC-1        /THIS BLOCK BELONGS TO FREECORE?
        SMA CLA             /SKIP IF NO
        JMP AGAIN           /YES, RELEASE THIS BLOCK AND SO ON
/
        JMP I INITFC        /RETURN
```

```
/REQUEST A FREE BLOCK                                          Ø66
/THE ROUTINE ISOLATES A BLOCK FROM THE TAIL OF THE
/CHAIN OF FREE CORE BLOCKS, AND LINKS IT TO THE BLOCK,
/POINTED TO BY THE AC.  IF THE AC=Ø NO LINK IS MADE
/THIS IS FOR THE VERY FIRST REQUEST.
/IN CASE OF ERROR RETURN: AC=Ø; ELSE AC
/POINTS TO FIRST LOC OF REQUESTED NEW BLK.
/
/       TAD (ANY LOC. IN PREVIOUS BLOCK, OR AC=Ø
/       CIF Ø
/       JMS REQBLK
/          ERROR RETURN /NO MORE BLKS AVAILABLE
/          NORMAL RETURN

        Ø                   /TEMPORARY STORAGE
REQBLK=.
RBLK,   .-.
        DCA RBLK-1          /SAVE
        RDF
        TAD C62Ø3
        DCA RBLRET
        CDF Ø
        TAD RBLK-1
        SNA
        JMP RBLK2
        AND C777Ø           /MAKE POINTER TO LINK LOCATION.
        TAD C7
        DCA RBLK-1
        TAD FREEF           /POINTS TO TAIL
        SNA
        JMP RBLRET          /Ø = NO BLKS AVAILABLE
        DCA I RBLK-1        /MAKE LINK TO NEW BLK
RBLK2.  TAD FREEF           /FIND NEW TAIL.
        SNA
        JMP RBLRET          /NO MORE BLKS AVAILABLE
        TAD C7
        DCA RBLK-1
        TAD I RBLK-1        /UPDATE FREEFIRST (THE TAIL)
        DCA FREEF
        DCA I RBLK-1        /ZERO THE LINK OF REQ BLK
        CMA
        TAD FREECT          /DECREMENT THE NUMBER OF AVAILABLE FREE
        DCA FREECT          /BLOCKS
        TAD RBLK-1          /TAKE POINTER TO REQ BLK.
        AND C777Ø           /FST LOC OF BLK
        ISZ RBLK
RBLRET, Ø
        JMP I RBLK          /NORMAL RETURN.
```

```
/RELEASE A BLOCKLET TO FREECORE.                                    Ø67
/THE BLOCK POINTED TO BY THE AC. IS LINKED TO THE
/TAIL OF THE CHAIN OF FREE CORE BLOCKS WITH ITS
/CONTENTS ZEROED.
/EXIT IS ALWAYS WITH AC =Ø. THERE IS NO ERROR EXIT.

/       TAD (POINTER
/       CIF Ø
/       JMS RELBLK
/          NORMAL RETURN/AC=Ø

RELBLK=.
RLBL,   .-.
        AND C7770       /KILL BIT 9-11
        TAD C7          /INSERT BIT 9-11
        DCA RBLK        /SAVE TEMP
        RDF
        TAD C6203
        DCA RLBRET
        CDF Ø
        TAD FREEF       /GET ADDR. OF NEXT FREE FREEBLK
        DCA I RBLK     /CHAIN THIS BLOCK TO THE
                        /FREE CHAIN
        TAD RBLK
        AND C7770       /SET UP ADDR.OF THIS BLOCK
        DCA FREEF       /STORE AT PAGE Ø
        TAD M7         /SET UP COUNTER
        DCA RBLK-1
        TAD FREEF       /GET ADDR. OF FIRST WORD IN BLOCK
        DCA RBLK
        DCA I RBLK
        ISZ RBLK
        ISZ RBLK-1        /INCR. COUNT
        JMP .-3         /AGAIN IF CNT NONZERO
        ISZ FREECT      /INCR. NR. OF FREE BLOCKS
RLBRET, Ø
        JMP I RLBL      /RETURN
```

```
/RELEASE A Q OF FORWARD LINKED BLOCKLETS TO FC.                    Ø68

/       TAD (POINTER IN FIRST BLKLT
/       CIF MONFLD
/       JMS RELQ
/         NORMAL RETURN /AC=Ø


        Ø                       /TEMPORARY
        Ø                       /TEMPORARY

RELQ,   •-•
        DCA RELQ-1              /SAVE AC
        RDF                     /MAKE RETURN
        TAD C62Ø3
        CDF MONFLD
        DCA RELQR
        TAD RELQ-1
RELQ2,  AND C7772               /MAKE -> FORWARD LINK
        TAD C7
        DCA RELQ-1
        TAD I RELQ-1            /PICK UP FORWARD LINK
        DCA RELQ-2
        TAD RELQ-1              /RELEASE THIS BLKLT
        JMS RELBLK
        TAD RELQ-2              /IF FORWARD LINK=Ø;END OF CHAIN
        SZA
        JMP RELQ2
RELQR,    Ø
        JMP I RELQ
```

```
/MAKE A BUFFER OR QUEUE IN FREECORE
/THE ROUTINE CREATES A 'BOOKKEEPING' BLOCK AND THE
/FIRST BLOCK OF THE BUFFERQUEUE. IT SETS THE PARA-
/METERS OF 'BOOK' ACCORDINGLY.
/THE CONTENTS OF THE AC IS USED TO SET THE MAXIMUM
/ALLOWABLE LENGTH OF THE BUFFER.  RETURN IS WITH THE
/POINTER TO 'BOOK' IN THE AC. IN CASE OF ERROR RETURN
/(NO ROOM AVAILABLE),AC=0. AND THERE WILL ALSO BE NO
/'BOOK' BLOCK.

/       TAD (MAXIMUM LENGTH
/       CIF 0
/       JMS MAKQ
/          ERROR RETURN          /AC=0
/          NORMAL RETURN         /AC= PTR TO 'BOOK'


        0                   /TEMP. POINTER
        0                   /POINTS TO FST LOC IN BUF
        0                   /POINTS TO 'BOOK'
        0                   /'MAXIMUM'
MAKQ,   0
        DCA MAKQ-1          /SAVE
        RDF
        TAD C6203
        DCA MAKRET
        CDF 0
        TAD MAKQ-1
        SNA                 /CHECK FOR AC=0
        JMP MAKRET          /ERROR AC=0
        DCA MAKQ-1          /SAVE
        JMS REQBLK                  /REQ. 'BOOK' BLK
        JMP MAKRET          /NO ROOM;ERROR
        DCA MAKQ-2          /SAVE 'BOOK' PTR
        TAD MAKQ-2          /REQ. FIRST BUF BLK
        JMS REQBLK
        JMP MAKQ2           /NOT AVAILABLE
        DCA MAKQ-3          /SAVE PTR TO FST BUFBLK

/THE 'BOOK' BLK IS SET UP AS FOLLOWS:
/BOOK,  0                   /'DATA'
/       BUFPTR+1            /'BUFTAIL'
/       0                   /'BUFCOUNT'
/       BUFPTR              /'BUFHEAD'
/       MAXIMUM
/       0
/       0
/       0
```

```
        TAD MAKQ-2      /SET UP TEMP PTR
        DCA MAKQ-4
        ISZ MAKQ-4      /POINTS 'BUFTAIL'
        TAD MAKQ-3
        IAC
        DCA I MAKQ-4
        ISZ MAKQ-4      /SET UP 'BUFHEAD'
        ISZ MAKQ-4
        TAD MAKQ-3
        DCA I MAKQ-4
        ISZ MAKQ-4      /SET UP 'MAXIMUM'
        TAD MAKQ-1
        DCA I MAKQ-4
        TAD MAKQ-2      /EXIT WITH PTR TO 'BOOK' IN AC
        ISZ MAKQ
MAKRET, Ø
        JMP I MAKQ

MAKQ2,  TAD MAKQ-2      /IF NO ROOM, RELEASE 'BOOK'BLK TOO
        JMS RELBLK
        JMP MAKRET
```

Ø7Ø

```
/READ NEXT ELEMENT FROM THE TAIL OF A BUFFER.
/THE AC MUST POINT TO A SECTION IN CORE WHERE THE
/BOOKKEEPING OF THIS BUFFER IS DONE. FORMAT IS:
/BOOK,   DATA              /TEMP. SAVE LOCATION, ONE ELEMENT
/        BUFTAIL           /TAIL OF BUFFER, FIRST LOC.
/        BUFCOUNT          /# OF ELEMENTS NOW IN BUF
/        BUFHEAD           /HEAD OF BUFFER, LAST LOC.
/        MAXIMUM           /MAX # OF ELEMENTS ALLOWED

/        TAD (BOOK
/        CIF Ø
/        JMS RBUF
/          BUF EMPTY RET. AC=Ø
/          RETURN WITH ELEMENT IN AC.

         Ø                 /TEMPORARY
         Ø                 /   "
RBUF=.
RB,      Ø
         DCA RB-1          /SAVE POINTER TO BOOK
         RDF
         TAD C6203
         DCA RBRET
         CDF Ø
         CLL CML RTL       /AC=2
         TAD RB-1
         DCA RB-2          /POINTS TO BUFCOUNT
         TAD I RB-2        /IS BUF EMPTY?
         SNA
         JMP RBRET         /YES, ERROR RETURN
         TAD M1            /NO, COUNT-1
         DCA I RB-2
         ISZ RB-1          /POINTS TO BUFTAIL
         TAD I RB-1        /IS THIS THE LINK?
         DCA RB-2
         TAD I RB-1
         AND C7
         TAD M7
         SZA CLA
         JMP RB2           /NO
         TAD I RB-2        /YES, GET LINK TO NXT BLK.
         DCA I RB-1        /UPDATE BUFTAIL
         TAD RB-2          /NOW RELEASE BLOCK
         JMS RELBLK
RB2,     TAD I RB-1        /FETCH ELEMENT
         DCA RB-2
         ISZ I RB-1        /BUFTAIL+1 FOR NXT ENTRY
         TAD I RB-2
         ISZ RB
RBRET,   Ø
         JMP I RB
```

```
/WRITE AN ELEMENT ONTO THE TOP OF A BUFFERQUEUE
/IN FREECORE. BUF FULL RETURN IS TAKEN
/WHEN BUFFER FULL OR NO FREE BLOCKS AVAILABLE.
/BUF FULL RET IS ALSO TAKEN WHEN THE LAST CHAR
/COULD JUST BE STORED. SUCCESSIVE ATTEMPTS LOSE DATA.
/
/       TAD ELEMENT     /STORE IN 'DATA'
/       CIF 0
/       JMS WBUF
/          BOOK         /POINTER TO BOOK BLK, FLD0
/          BUF FULL RETURN      /AC=0; ALSO IF F.C. FULL
/          NORMAL RETURN        /AC=0


        0               /FLAG;-1 IF LAST ELEMENT
        0               /DATA STORE
        0               /TEMPORARY
        0               /  "
WB,     0
        DCA WB-3
        TAD I WB        /PICK UP BOOKPTR
        DCA WB-1
        ISZ WB
        RDF
        TAD C6203
        DCA WBRET
        CDF 0
        ISZ WB-1
        ISZ WB-1        /POINTS TO 'BUFCOUNT'
        CLL CML RTL     /AC=2
        TAD WB-1
        DCA WB-2        /POINTS TO 'MAXIMUM'
        TAD I WB-2      /BUF FULL?
        CIA
        TAD I WB-1
        SMA
        JMP WBRET       /YES, ERROR
        DCA WB-4        /FLAG  FOR LAST ELEMENT
        TAD WB-1
        IAC
        DCA WB-2        /POINTS TO 'BUFHEAD'
        ISZ I WB-2      /BUFHEAD+1GIVES NXT FREE LOC.
        TAD I WB-2      /IS THIS THE LINK?
        AND C7
        TAD M7
        SZA CLA
        JMP WB2         /NO
        TAD I WB-2      /YES, REQUEST A FREE BLK
        JMS REQBLK
        JMP WBRET       /NO ROOM; ERROR;AC=0
        DCA I WB-2      /UPDATE BU'BUFHEAD'
WB2,    TAD I WB-2      /PUT DATA IN BUF
        ISZ I WB-1      /BUFCOUNT+1
        DCA WB-2
        TAD WB-3
        DCA I WB-2
        ISZ WB-4        /ERR.RET. IF LAST ELEMENT
        ISZ WB          /NORMAL RET
WBRET,  0
        JMP I WB
```

```
/KILL THE BUFFER QUEUE
/THIS OPERATION, WHICH MAY BE TIME-CONSUMING, RELEASES
/ALL THE BUFFERBLKS TO FREECORE, ALSO THE 'BOOK' BLK.

/       TAD (POINTER TO 'BOOK'
/       CIF Ø
/       JMS KILLQ
/          NORMAL RETURN          /AC=Ø

        Ø                   /TEMP. LINK
        Ø                   /POINTS LINK OF THIS BLK
        Ø                   /POINTS IN 'BOOK'
KILLQ,  Ø
        DCA KILLQ-1         /SAVE
        RDF
        TAD C6203
        DCA KILLRT
        CDF Ø
        ISZ KILLQ-1         /POINTS 'BUFTAIL'
        TAD I KILLQ-1
        AND C7770
KILLQ2, TAD C7              /POINTS TO LINK
        DCA KILLQ-2
        TAD I KILLQ-2       /GET LINK
        DCA KILLQ-3
        TAD  KILLQ-2        /NOW RELEASE BLK
        JMS RELBLK
        TAD KILLQ-3         /WAS IT LAST BLK OF QUEUE?
        SZA
        JMP KILLQ2          /NO, SEARCH NEXT
        TAD KILLQ-1         /YES, KILL 'BOOK' TOO
        JMS RELBLK
KILLRT, Ø
        JMP I KILLQ
```

Ø73

```
/ROUTINES TO CONVERT OCTAL NUMBERS Ø-17
/TO EXESS 4Ø STRIPPED CODE
/
/INPUT OCTAL
/OUTPUT OCTAL
/
/EXAMPLE:15 --> 2125
/         Ø7 --> 2Ø27
/
        TAD M1Ø
        SMA
        TAD C7Ø
        TAD C2Ø3Ø
/**********************************
/INPUT OCTAL
/OUTPUT OCTAL
/LEADING ZERO'S BECOME PACKED SPACES
/
/EXAMPLE:15 --> 2125
/         Ø7 --> ØØ27
/
        TAD M1Ø
        SMA
        TAD C2Ø7Ø
        TAD C3Ø
/**********************************
/INPUT OCTAL
/OUTPUT DECIMAL
/
/EXAMPLE:15 --> 2123
/         Ø7 --> 2Ø27
/
        TAD M12
        SMA
        TAD C66
        TAD C2Ø32
/**********************************
/INPUT OCTAL
/OUTPUT DECIMAL
/LEADING ZERO'S BECOME PACKED SPACES
/
/EXAMPLE:15 --> 2123
/         Ø7 --> ØØ27
/
        TAD M12
        SMA
        TAD C2Ø66
        TAD C32
/**********************************
/GENERAL CONSTANTS:
/
M1Ø,    -1Ø
M12,    -12
C3Ø,    3Ø
C32,    32
C66,    66
C7Ø,    7Ø
C2Ø3Ø,  2Ø3Ø
C2Ø32,  2Ø32
C2Ø66,  2Ø66
C2Ø7Ø,  2Ø7Ø
/
```

Ø74

```
/INTERRUPT ROUTINE FOR REALTIME CLOCK
/
/TIME AND DATE ARE AVAILLABLE IN REGISTERS
/        MIN
/        HOUR
/        DAY
/        MONTH
/        YEAR
/
/OPTIONAL DAY OF WEEK AVAILLABLE IN REGISTER
/        DAYW     1=SUNDAY
/                 2=MONDAY
/                 ETC.
/
/ENTRY AFTER CLOCK INTERRUPT
/WITH AC AND LINK SAVED
/
CLOCK,  ISZ  TICK
        JMP  EXIT               /RETURN FROM INTERRUPT
        TAD  M50                /50 HERTZ
        DCA  TICK               /RESET TICK = -50
        ISZ  SEC
        JMP  EXIT
        TAD  M60
        DCA  SEC                /RESET SEC = -60
        ISZ  MIN
        TAD  MIN
        TAD  M60                /60 MINUTES GONE?
        SZA  CLA
        JMP  EXIT               /NO
        DCA  MIN                /YES, RESET MIN =0
        ISZ  HOUR
        TAD  HOUR
        TAD  M24
        SZA  CLA                /24 HOURS GONE?
        JMP  EXIT               /NO
        DCA  HOUR               /YES, RESET HOUR = 0
        ISZ  DAY
        TAD  DAYW               /*********************
        IAC                     /*IF DAY OF WEEK IS
        AND  C7                 /*NOT IMPORTANT DELETE
        SNA                     /*THESE INSTRUCTIONS
        IAC                     /*
        DCA  DAYW               /*********************
        TAD  MONTH
        TAD  MONLST             /#  OF DAY / MONTH
        DCA  TEMP
        TAD  DAY
        TAD  I TEMP
        SPA SNA CLA             /LAST DAY OF MONTH?
        JMP  EXIT
```

```
        IAC                     /YES
        DCA DAY                 /RESET DAY = 1
        ISZ MONTH
        TAD MONTH
        TAD M12
        SPA SNA CLA             /LAST MONTH OF YEAR?
        JMP EXIT
        IAC                     /YES
        DCA MONTH               /RESET MONTH = 1
        ISZ YEAR
        TAD YEAR
        AND C3
        SZA CLA                 /IS IT A LEAPYEAR?
        JMP NLY                 /NO LEAPYEAR
        TAD YEAR                /MAY BE!
LOOP,   CLL
        TAD M400
        SNL
        JMP N400V
        SZA
        JMP LOOP
        JMP NLY-1               /YEAR=MULTIPLE 400
N400V,  TAD C100                /LEAPYEAR
        SPA
        JMP N400V
        SZA CLA
        CLA CMA
NLY,    TAD M28                 /SET FEB TO 28 OR 29 DAYS
        DCA MONLST+2
        JMP EXIT
/
        DECIMAL
MONLST, MONLST
        -31
        -28
        -31
        -30
        -31
        -30
        -31
        -31
        -30
        -31
        -30
        -31
/
MIN,    0
HOUR,   0
DAY,    0
DAYW,   0                       /DAY OF THE WEEK, OPTIONAL!
MONTH,  0
YEAR,   1973
/
```

```
/GENERAL CONSTANTS
/
M50,    -50
M60,    -60
M24,    -24
M28,    -28
M12,    -12
M400,   -400
C100,   100
        OCTAL
C7,     7
C3,     3
TICK,   0
SEC,    0
/GENERAL INTERRUPT TERURN
/
EXIT,   CLA CLL
        TAD LINK
        RAR
        TAD ACCU
        ION
        JMP I 0
/
TEMP,   0
ACCU,   0
```

```
LINK,  Ø

/PRINT DATE,WEEKDAY AND TIME FROM THE REGISTERS:                    Ø75
/       MIN         /Ø-59
/       HOUR        /Ø-23
/       DAY         /1-31
/       DAYW        /1- 7
/       MONTH       /1-12
/       YEAR
/
/USING THE SUBROUTINES:
/          PRMESG              /PRINT MESSAGE
/          DPRT1               /DECIMAL PRINT
/          PRINT               /STANDARD PRINT ROUTINE
/
PRDAT, Ø
       TAD DAYW
       TAD DTXTAD
       DCA PRTMP
       TAD I PRTMP
       DCA PRDAT1
       JMS PRMESG
PRDAT1,Ø
       JMS SPAC
       TAD DAY
       JMS DPRT1
       2
       JMS SPAC
       TAD MONTH
       TAD MTXTAD
       DCA PRTMP
       TAD I PRTMP
       DCA PRDAT2
       JMS PRMESG
PRDAT2,Ø
       JMS SPAC
       TAD YEAR
       JMS DPRT1
       4
       JMS SPAC
       TAD HOUR
       JMS DPRT1
       2
       TAD DOT
       JMS PRINT
       TAD MIN
       JMS DPRT1
       2
       JMP I PRDAT
/
PRTMP= .
SPAC,  Ø
       TAD C240
       JMS PRINT
       JMP I SPAC
```

```
/
DOT,    ".
C240,   240
/
/
DTXTAD, DTXTAD
        SUN
        MON
        TUES
        WED
        THUR
        FRI
        SAT
/
MTXTAD, MTXTAD
        JAN
        FEB
        MAR
        APR
        MAY
        JUN
        JUL
        AUG
        SEP
        OCT
        NOV
        DEC
/
JAN,    TEXT "JANUARY   "
FEB,    TEXT "FEBRUARY  "
MAR,    TEXT "MARCH     "
APR,    TEXT "APRIL     "
MAY,    TEXT "MAY       "
JUN,    TEXT "JUNE      "
JUL,    TEXT "JULY      "
AUG,    TEXT "AUGUST    "
SEP,    TEXT "SEPTEMBER"
OCT,    TEXT "OCTOBER   "
NOV,    TEXT "NOVEMBER  "
DEC,    TEXT "DECEMBER  "
/
/
        PAGE
/
MON,    TEXT "MONDAY    "
TUES,   TEXT "TUESDAY   "
WED,    TEXT "WEDNESDAY"
THUR,   TEXT "THURSDAY  "
FRI,    TEXT "FRIDAY    "
SAT,    TEXT "SATURDAY  "
SUN,    TEXT "SUNDAY    "
/
```

Ø76

```
/SUBROUTINE TO UNPACK TSS-8 TIME
/
/CALL: JMS UNPTIM   /WITH AC=Ø
/
/RESULT IN REGISTERS:
/            HOUR    /Ø-23
/            MIN     /Ø-59
/            SEC     /Ø-59
/
/THIS ROUTINE ASSUMES THAT THE SYSTEM CLOCK RATE
/IS 2Ø SYSTEM TICKS PER SECOND,
/IF OTHER, CHANGE CONSTANTS AT UNPTHI UP TO UNPTLO+2
/
/
UNPTIM, Ø
        TAD UNPTAD
        TOD                     /GET TIME OF DAY
        TAD UNPTHA
        DCA UNPTPH              /SET POINTERS
        TAD UNPTLA
        DCA UNPTPL
        TAD UNPTOT
        DCA UNPTPO
        CLA CLL CMA RTL         /-3
        DCA UNPTCT
UNPTLP, DCA UNPTNM              /CLEAR NUMBER
        TAD UNPTL
        CLL
        TAD I UNPTPL
        DCA UNPTMP
        RAL
        TAD UNPTH
        TAD I UNPTPH
        SNL
        JMP UNPTND
        DCA UNPTH               /RESTORE HIGH REMAINDER
        TAD UNPTMP
        DCA UNPTL               /RESTORE LOW REMAINDER
        ISZ UNPTNM              /COUNT THIS SUBTRACTION
        JMP UNPTLP+1
UNPTND, CLA
        TAD UNPTNM              /GET NUMBER
        DCA I UNPTPO            /PUT IN SPEC. REGISTER
        ISZ UNPTPH              /UPDATE POINTERS
        ISZ UNPTPL
        ISZ UNPTPO
        ISZ UNPTCT              /READY?
        JMP UNPTLP              /NO, LOOP
        JMP I UNPTIM            /YES, EXIT
/
```

```
UNPTAD, UNPTH
UNPTH,  0
UNPTL,  0
UNPTNM, 0
UNPTCT, 0
UNPTMP, 0
UNPTPO, 0
UNPTOT, HOUR
        MIN
        SEC
UNPTPL, 0                       /LOW ORDER POINTER
UNPTPH, 0                       /HI  ORDER POINTER
UNPTHA, UNPTHI                  /ADDR. OF HI  ORDER CONSTANTS
UNPTLA, UNPTLO                  /ADDR. OF LOW ORDER CONSTANTS
UNPTHI, 7756                    /-# OF TICKS/HOUR=-72000 DEC.
        7777                    /-# OF TICKS/MIN =- 1200 DEC.
        7777                    /-# OF TICKS/SEC =-   20 DEC.
UNPTLO, 3300
        5520
        7754
/
HOUR,   0
MIN,    0
SEC,    0
```

Ø77

```
/SUBROUTINE TO UNPACK TSS-8 TIME
/
/CALL: JMS UNPTIM   /WITH AC=0
/
/RESULT IN REGISTERS:
/            HOUR    /0-23
/            MIN     /0-59
/            SEC     /0-59
/
/THIS ROUTINE WORKS FOR ANY CLOCKRATE
/
/
UNPTIM, 0
        RCR
        CIA
        DCA  UNPTDV             /PUT IN DIVISOR LIST
        TAD  UNPTAD
        TOD                     /GET TIME OF DAY
        TAD  UNPTDA
        DCA  UNPTPD
        TAD  UNPTOT
        DCA  UNPTPO
        TAD  M4
        DCA  UNPTCT
UNPTLP, DCA  UNPTNM             /CLEAR NUMBER
        DCA  UNPTNM+1
        TAD  UNPTL
        CLL
        TAD  I UNPTPD
        DCA  UNPTMP
        SNL
        CLA  CMA
        TAD  UNPTH
        SNL
        JMP  UNPTND
        DCA  UNPTH              /RESTORE HIGH REMAINDER
        TAD  UNPTMP
        DCA  UNPTL              /RESTORE LOW REMAINDER
        ISZ  UNPTNM             /COUNT THIS SUBTRACTION
        SKP
        ISZ  UNPTNM+1           /HI ORDER RESULT
        JMP  UNPTLP+2
UNPTND, CLA
        TAD  UNPTNM+1
        DCA  UNPTH
        TAD  UNPTNM             /GET NUMBER
        DCA  I UNPTPO           /PUT IN SPEC. REGISTER
        ISZ  UNPTPD             /UPDATE POINTERS
        ISZ  UNPTPO
        ISZ  UNPTCT             /READY?
        JMP  UNPTLP             /NO, LOOP
        JMP  I UNPTIM           /YES, EXIT
/
```

```
UNPTAD, UNPTH
UNPTNM, Ø                       /LOW   ORDER
        Ø                       /HIGH  ORDER
UNPTCT, Ø
UNPTMP, Ø
UNPTPO, Ø
UNPTOT, UNPTL
        HOUR
        MIN
        SEC
UNPTPD, Ø                       /POINTER IN DIV LIST
UNPTDA, UNPTDV
/
        DECIMAL
/
UNPTDV, Ø
        -3600
        -60
        -1
/
        OCTAL
/
/
UNPTH,  Ø
UNPTL,  Ø
HOUR,   Ø
MIN,    Ø
SEC,    Ø
/
M4,     -4
```

078

```
/SUBROUTINE TO UNPACK TSS8 DATE
/
/RESULT IN REGISTERS
/         DAY       /1-7
/         MONTH     /1-12
/         YEAR      /ANY
/
UNPDAT, 0
        DATE                    /GET DATE FROM TS8
        DCA DAY
        JMS DATDIV              /DEVIDE BY
        -564                    /564(SUBTRACT)
        TAD TIMES
        TAD C1964               /AC=YEAR-1964 (DEC)
        DCA YEAR
        JMS DATDIV              /DEVIDE REST BY 37
        -37
        ISZ TIMES               /MONTHS MUST BE +1
        TAD TIMES
        DCA MONTH
        ISZ DAY                 /REMINDER IS DAYS-1
        JMP I UNPDAT
/
/SUBROUTINE DATDIV DEVIDES 'DAY' BY GIVEN NUMBER
/
DATDIV, 0
        DCA TIMES               /CLEAR RESULT
DATD1,  CLL
        TAD DAY                 /NUMBER TO DEVIDE
        TAD I DATDIV            /NUMBER TO DEVIDE BY
        SNL                     /READY?
        JMP DATD2               /YES
        DCA DAY                 /NO STORE REST
        ISZ TIMES               /COUNT SUBTRACTION
        JMP DATD1               /SUBTRACT ONE'S MORE
DATD2,  CLA CLL                 /REST IS IN NUMB
        ISZ DATDIV
        JMP I DATDIV            /EXIT
/
TIMES,  0
C260,   260
DAY,    0
MONTH,  0
YEAR,   0
/
        DECIMAL
C1964,  1964
        OCTAL
```

Ø79

```
/DECIMAL PRINT WITH VARIABLE NUMBER OF DIGITS
/
/CALL WITH NUMBER TO BE PRINTED IN AC
/AND # OF DIGITS TO BE PRINTED
/FOLLOWING THE SUBROUTINE CALL.
/
/CALL: TAD NUMBER
/      JMS DPRT1
/      2            /# OF DIGITS TO BE PRINTED (MAX=4)
/
/
DPRT1, Ø
       DCA DPRREG          /SAVE AC
       DCA DPRD            /CLEAR # OF PRINTED DIGITS
       TAD I DPRT1         /FETCH FORMAT
       DCA DPRDIG
       ISZ DPRT1           /CORRECT RETURN
       TAD DPRINS
       DCA DPRPTR          /SET POINTER
       CLA CLL CMA RTL     /-3
       DCA DPRFAC          /FACTORIZE 4 DIGITS
       DCA DPRDGT          /CLEAR DIGIT
DPRSUB, CLL
       TAD DPRREG
DPRPTR, Ø                  /SUBTRACT
       SNL                 /NEGATIVE?
       JMP .+4             /YES
       DCA DPRREG          /STORE RESULT OF SUBTRACTION
       ISZ DPRDGT          /NO, STEP UP DIGIT
       JMP DPRSUB
       CLA
       TAD DPRDGT          /GET DIGIT
       TAD DPRD
       SZA CLA             /PRINT THE DIGIT?
       JMP DPRDIN          /YES, GO ON
       TAD DPRFAC          /NO,
       TAD DPRDIG
       SPA SNA CLA         /PRINT A SPACE?
       JMP DPRTIN          /NO
       TAD C240            /YES
       JMP DPRPR
DPRDIN, ISZ DPRD
       TAD DPRDGT          /FETCH DIGIT
       TAD C260            /CONVERT TO ASCII
DPRPR, JMS PRINT
DPRTIN, ISZ DPRPTR         /STEP UP POINTER
       ISZ DPRFAC
       JMP DPRSUB-1
       TAD DPRREG          /FETCH LAST DIGIT
       TAD C260
       JMS PRINT
       JMP I DPRT1
/
```

```
DPTREG, 0
DPRD,   0
LPTDIG, 0
DPRFAC, 0
DPRDGT, 0
DPRINS, TAD DPRP
/
        DECIMAL
/
DPRP,   -1000
        -100
        -10
/
        OCTAL
/
/GENERAL CONSTANTS
/
C260,   260
C240,   240
```

```
/ OCTAL PRINT ROUTINE WITH LEADING SPACES
/NONSIGNIFICANT ZERO'S BECOME SPACES
/LINK NEEDS NOT TO BE PRESERVED BY 'PRINT' ROUTINE.
/
/CALL:   TAD NUMBER
/        JMS OCTPRT
/                  RETURNS WITH AC=Ø
/
OCTPRT,  Ø
         DCA      OCTTMP
         TAD      M4
         DCA      OCTCNT
         CMA
OCTPRØ,  DCA      OCTFIG
         TAD      OCTTMP
         RAL
         RTL
         DCA      OCTTMP
         TAD      OCTTMP
         RAL
         AND      C7
         ISZ      OCTCNT
         JMP      .+4
         TAD      C26Ø
         JMS      PRINT
         JMP I    OCTPRT

         SNA
         ISZ      OCTFIG
         JMP      .+4
         TAD      C24Ø
         JMS      PRINT
         JMP      OCTPRØ-1

         TAD      C26Ø
         JMS      PRINT
         JMP      OCTPRØ

OCTTMP,  Ø
OCTCNT,  Ø
OCTFIG,  Ø
M4,      -4
C7,      7
C24Ø,    24Ø
C26Ø,    26Ø
```

```
/ DOUBLE WORD OCTAL PRINT ROUTINE                                  Ø81
/
/CALL:   JMS DOCTPR
/        HIORDER PART
/        LOWORDERPART
/                RETURN AC=Ø
/
DOCTPR,  Ø
         CLA
         TAD I    DOCTPR
         ISZ      DOCTPR
         DCA      OCTTM1
         TAD I    DOCTPR
         ISZ      DOCTPR
         DCA      OCTTM2
         TAD      M1Ø
         DCA      OCTCNT
         CMA
OCTPR1,  DCA      OCTFIG
         JMS      DBLROT
         JMS      DBLROT
         JMS      DBLROT
         TAD      OCTTM2
         RAL
         AND      C7
         ISZ      OCTCNT
         JMP      .+4
         TAD      C26Ø
         JMS      PRINT
         JMP I    DOCTPR

         SNA
         ISZ      OCTFIG
         JMP      .+4
         TAD      C24Ø
         JMS      PRINT
         JMP      OCTPR1-1

         TAD      C26Ø
         JMS      PRINT
         JMP      OCTPR1

OCTTM1,  Ø
OCTTM2,  Ø
OCTCNT,  Ø
OCTFIG,  Ø
M1Ø,     -1Ø
C7,      7
C24Ø,    24Ø
C26Ø,    26Ø

DBLROT,  Ø
         TAD      OCTTM2
         RAL
         DCA      OCTTM2
         TAD      OCTTM1
         RAL
         DCA      OCTTM1
         JMP I    DBLROT
```

Ø82

```
/ASCII STRING GENERATOR
/GENERATES THE 64-CHARACTER ASCII SET IN A STRING
/TERMINATED WITH CARRIAGE RETURN, LINE FEED
/
/CALL:  CLA
/       JMS     GENSTR
/               RETURN (AC=Ø)

        Ø       /END OF PARTIAL STRING
        Ø       /POINTER
        Ø       /TEMPORARY STORAGE
GENSTR, •-•
        TAD     GENLST
        DCA     GENSTR-2/INITIALIZE POINTER
        TAD     GENSTR-2
        TAD     GENLTH
        DCA     GENSTR-1
        TAD I   GENSTR-1/GET NEXT CHARACTER
        DCA     GENSTR-1
        ISZ     GENSTR-2/INCREMENT POINTER
        TAD I   GENSTR-2
        SNA             /END OF LIST ?
        JMP I   GENSTR  /YES
        CIA
        DCA     GENSTR-3/SET UP TO TEST
GENLP,  TAD     GENSTR-1
        JMS     PRINT
        ISZ     GENSTR-1/CHARACTER +1
        TAD     GENSTR-1
        TAD     GENSTR-3
        SPA SNA CLA     /EQUAL TO POINTED CHARACTER ?
        JMP     GENLP
        JMP     GENSTR+3/YES, GET NEXT CHARACTER

GENLTH, GENNXT-GENLST
GENLST, •
        332     /Z
        271     /9
        257     /SLASH
        300     /@
        337     /←
        215     /RETURN
        212     /LINE FEED
        Ø       /TERMINATOR

GENNXT, 301     /A
        260     /Ø
        240     /SPACE
        272     /:
        333     /[
        215     /RETURN
        212     /LINE FEED
```

Ø83

```
/INCREMENT DOUBLE PRECISION COUNTER
/WITH OVERFLOW RETURN (AFTER 16,777,216 INCREMENTS)
/
/CALL:   JMS      DPINC
/                 DPCNTR   /ADDRESS OF COUNTER
/                 COUNTER OVERFLOWED RETURN (AC=Ø)
/                 NORMAL RETURN (AC=Ø)
/
/        DPCNTR,  Ø        /HIGH ORDER PART
/                 Ø        /LOW ORDER PART

         Ø                  /TEMPORARY ADDRESS
DPINC,   .-.
         CLA CLL  IAC       /SET UP TO GET ADDRESS OF
         TAD I    DPINC     / LOW ORDER PART
         DCA      DPINC-1
         ISZ I    DPINC-1
         JMP      DPINC1    /NO OVERFLOW
         CML
         SZL
         JMP      DPINC+2   /INCREMENT HIGH ORDER PART
         SKP                /HIGH ORDER PART OVERFLOW
DPINC1,  ISZ      DPINC
         ISZ      DPINC
         JMP I    DPINC
```