DATA GENERAL
CORPORATION
Southboro,
Massachusetts 01772
(617) 485-9100

PROGRAM

Single Precision Binary to BCD

TAPES

ASCII Source: 090-000028

ABSTRACT

This routine converts a single precision binary number to its
four digit BCD equivalent.

1. REQUIREMENTS

1.1 Memory

1K or larger alterable memory

1.2 Equipment

NOVA central processor

1.3 External Subroutines

None

1.4 Other

None

2. OPERATING PROCEDURE

2.1 Calling Sequence

```
JSR  .BBCD
return
```

2.2 Input Format

A positive binary number in AC1.

2.3 Output Format

The four digit (16-bit) BCD equivalent of the binary input is returned in AC1.

2.4 Error Returns

If a number greater than 9999 is input for conversion, Carry is set to indicate an error (only four digits of BCD information can be accomodated in 16 bits). Otherwise, Carry will be zero on return.

2.5 State of Active Registers upon Exit

AC∅ and AC2 are unchanged. AC1, AC3, and Carry are destroyed.

2.6 Cautions to User

None

3. DISCUSSION

3.1 Algorithms

The binary input is compared to 1∅,∅∅∅. If greater than or equal to, Carry is set to indicate an error and return is made. Otherwise, each of the four BCD digits is determined by successively subtracting an appropriate power of ten from the original value until the result is negative. Each subtraction that gives a result greater than or equal to zero causes the current BCD digit to be incremented. When the result becomes negative, its previous value is restored and the next lower power of ten is subtracted. After 1∅**∅ is used, the conversion is complete.

3.2 Limitations and Accuracy

The routine is exact for all binary values less than 1∅,∅∅∅ decimal.

3.3 Size and Timing

The routine is 41 (octal) words in length.

Execution time is 273.8 + N * 14.1 μ seconds, where N is the sum of the digits of the result. For example, if the input is decimal 479∅, N = 4 + 7 + 9 + ∅ = 2∅, and the execution time is

$$273.8 + 2\emptyset * 14.1 = 555.8 \; \mu \text{ seconds.}$$

3.4 References

None

3.5 Flow Diagrams

None

4. EXAMPLES AND APPLICATIONS

The ASCII source of .BBCD is provided with the NOVA software. If a user routine requires binary to BCD conversion, the tape should be edited into the user's source.

5. PROGRAM LISTING

A listing of .BBCD follows. No origin is given in the source, enabling the tape to be edited anywhere within a user routine.

```
; CONVERT A NUMBER IN BINARY TO BCD

; INPUT:            AN UNSIGNED BINARY NUMBER IN AC1

; OUTPUT:           THE BCD EQUIVALENT IN AC1

; CALLING SEQUENCE:
;        JSR      .BBDC
;        RETURN

; EXCEPTIONAL CONDITION:       IF AC1 CONTAINS A
;                             NUMBER GREATER THAN 9999,
;                             NO CONVERSION WILL TAKE PLACE
;                             AND CARRY WILL BE SET

; UNCHANGED:   AC0, AC2
; DESTROYED:   AC1, AC3, AND CARRY

00000 054032 .BBCD:   STA 3,.EB03      ; SAVE RETURN
00001 034037          LDA 3,.EB20      ; TEST FOR >= 10000
00002 136042          ADCO 1,3,SZC
00003 002032          JMP @.EB03       ; ERROR, CARRY IS SET
00004 040030          STA 0,.EB00      ; SAVE AC0
00005 050031          STA 2,.EB02      ; SAVE AC2
00006 034040          LDA 3,.EB30      ; ADDRESS OF POWER OF TEN TABLE
00007 102400          SUB 0,0          ; CLEAR ACO FOR RESULT

00010 031400 .EB98:   LDA 2,0,3        ; GET CURRENT POWER OF TEN
00011 175400          INC 3,3          ; BUMP POINTER
00012 101120          MOVZL 0,0        ; SHIFT AC0 LEFT 4 PLACES
00013 101120          MOVZL 0,0
00014 101120          MOVZL 0,0
00015 101120          MOVZL 0,0
00016 146422          SUBZ 2,1,SZC     ; DOES POWER OF TEN GO IN?
00017 101401          INC 0,0,SKP      ; YES, BUMP RESULT
00020 147001          ADD 2,1,SKP      ; NO, RESTORE RESULT
00021 000016          JMP .-3          ; LOOP TILL DOESN'T
00022 151224          MOVZR 2,2,SZR    ; DONE IF 1 IN AC2
00023 000010          JMP .EB98        ; NO

00024 105020 .EB99:   MOVZ 0,1         ; RESULT TO AC1, CLEAR CARRY
00025 020030          LDA 0,.EB00      ; RESTORE AC0
00026 030031          LDA 2,.EB02      ; RESTORE AC2
00027 002032          JMP @.EB03       ; RETURN
```

```
---
↑ ↑ ↑
    00030 000000  .EB00:   0                    ; SAVE AC0
    00031 000000  .EB02:   0                    ; SAVE AC2
    00032 000000  .EB03:   0                    ; SAVE RETURN

          000012           .RDX 10
    00033 001750  .EB05:   1000                 ; 10**3
    00034 000144           100                  ; 10**2
    00035 000012           10                   ; 10**1
    00036 000001           1                    ; 10**0
          000010           .RDX 8


    00037 023420  .EB20:   23420                ; 10**4 ( > LARGEST LEGAL
                                                ; INPUT)

    00040 000033  .EB30:   .EB05                ; ADDRESS OF POWER OF TEN TABLE
```