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PROGRAM

Double Precision Absolute Value

TAPES

ASCII source: 090-000015

ABSTRACT

This routine computes the absolute value of a fixed point, double precision, two's complement number.

1. REQUIREMENTS

1.1 Memory

1K or larger memory

1.2 Equipment

NOVA central processor

1.3 External Subroutines

None

1.4 Other

None

2. OPERATING PROCEDURE

2.1 Calling Sequence

```
JSR    .DABS
return
```

2.2 Input Format

A fixed point, double precision, two's complement number in AC$\emptyset$, AC1 - high order in AC$\emptyset$, low order in AC1. The low order word is considered as an unsigned, 16-bit number. Bit $\emptyset$ of the high order word is considered the sign of the double precision number. A negative number, N, is represented as:

$$2**32-abs(N)$$

2.3 Output Format

The absolute value of the input returned in AC$\emptyset$, AC1 - high order in AC$\emptyset$, low order in AC1.

2.4 Error Returns

None

2.5 State of Active Registers upon Exit

AC$\emptyset$, AC1, and Carry are destroyed. AC2 and AC3 remain unchanged.

2.6 Cautions to User

The absolute value of -2**31 cannot be represented and will be returned unchanged.

3. DISCUSSION

3.1 Algorithms

The sign of the input is tested and, if negative, the input is negated.

If we consider the number to be of the form

$$2**16*A + B$$

where A and B represent contents of AC∅, AC1, the negate

$$= 2**32 - (2**16*A + B)$$
$$= 2**16* (2**16-A) + 2**32-B$$

2**32-B is merely a NEG of B, which will cause a borrow from the high order in every case but B=∅. The borrow means we must form

$$2**16-A-1$$

for the high order, which is a COM of A. If B was ∅, however, a NEG of A is required.

3.2 Limitations and Accuracy

The routine is exact.

3.3 Size and Timing

The routine is 6 instructions in length.

For $x \geq \emptyset$, execution time is 8.2 μ seconds.
For $x < \emptyset$, execution time is 19.4 μ seconds.

3.4 References

See section 2.2 of "How to use the NOVA" for a further discussion of double precision arithmetic.

3.5 <u>Flow Diagrams</u>

None

4. <u>EXAMPLES & APPLICATIONS</u>

An ASCII source tape (090-000015) of .DABS
is provided with the NOVA software. This tape
should be edited into the user routine that requires
double precision absolute value.

5. <u>PROGRAM LISTING</u>

A listing of .DABS follows. No origin has been given,
enabling the user to edit the routine anywhere into
his program.

```
; DOUBLE PRECISION ABSOLUTE VALUE
; COMPUTES THE ABSOLUTE VALUE OF A DOUBLE PRECISION,
;        FIXED POINT, TWO'S COMPLEMENT NUMBER

; INPUT:          N IN AC0, AC1 (HIGH AND LOW ORDERS)

; OUTPUT:         ABS(N) IN AC0, AC1

; CALLING SEQUENCE:
;        JSR     .DABS
;        RETURN

; CAUTION:        THE ABSOLUTE VALUE OF -2**31
;                 CANNOT BE REPRESENTED AND IS RETURNED
;                 UNCHANGED

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


00000 101113 .DABS:  MOVL# 0,0,SNC    ; TEST SIGN
00001 001400         JMP 0,3          ; POSITIVE - RETURN
00002 124404         NEG 1,1,SZR      ; NEGATE TO FORM ABSOLUTE VALUE
00003 100001         COM 0,0,SKP
00004 100400         NEG 0,0
00005 001400         JMP 0,3
```