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TWO ROUTINES TO CONVERT DATA TO UNITS IN DB FOR THE UNIVAC 1230--ETC(U)
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UNCLASSIFIED NUSC/NL-TM-2211-88-70 NL

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NUSC/NL Problem No.
A-408-00-00 R-2408

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TWO ROUTINES TO CONVERT DATA TO UNITS IN DB FOR THE UNIVAC 1230

by

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NUSC/NL Technical Memorandum No. NUSC/NL-TM-2211-88-70

21 August 1970

10 p.

INTRODUCTION

During project PARKA, data were received, digitized and processed in real time by the UNIVAC 1230 computer aboard the prime receiving vessel SANDS. The final form of the processed data was displayed as listings and graphs with the values being expressed in db. To convert the data to db, two generalized programs, 'TENLOGTEN'* and 'CONLOGIT' were written to calculate $P = 10 \log_{10} (X)$, where X is a fixed point number within a specified set of limits. The major differences between these two routines are the methods used to obtain the natural logarithm and the scaling necessary for the input values.

ADMINISTRATIVE INFORMATION

This memorandum was prepared under NUSC Project Title: Long-Range Acoustic Transmission Experiments for Surveillance Systems Development; R. Hasse and R. Martin, NUSC/NL Principal Investigators. The sponsoring activity was ONR, Code 102-OS; Dr. J. B. Hersey, Program Manager.

"TENLOGTEN"

Routine "TENLOGTEN" calculates $10 \log_{10} X$ by evaluating a 5th degree polynomial. Expressing $10 \log_{10} X$ as

* This routine was written for NUSL by TRACOR under contract for project PARKA.

$$b_5 = (10 \log_{10} e)a_5 = .13966237.$$

Routine "TENLOGTEN" calculates N and evaluates the above equation. A flow chart of "TENLOGTEN" is shown in Figure 1.

Program Usage

To call on routine "TENLOGTEN", enter the value X in the A register, scaled 22 bits, and RJP*TENLOGTEN. The answer appears in the Q register scaled 3 bits.

If the inputted number X is less than or equal to zero, the routine returns a value of 4000000000_8.

"CONLOGIT"

"CONLOGIT" also calculates $P = 10 \log_{10}(X)$, by obtaining the natural logarithm using a subroutine called "NATLOG"* and converting to P by equation (3). To use "NATLOG", the number X must be expressed in the form $X = N \cdot 2^S$ where $1 \leq N \leq 377777_8$. "CONLOGIT", assuming the scale factor, S is 15, checks N to see that it is within limits. If it is not, "CONLOGIT" shifts N down so that the most significant bit is in the proper position and then adjusts S accordingly.

"NATLOG" uses a method attributed to Dr. H. Maehly** to calculate the natural logarithm. Rewriting X as

$$X = 2^m F, \tag{5}$$

where m is an integer and $1 \leq F \leq 2$,

$$\ln(X) = (m+\tfrac{1}{2}) \ln 2 + P_0 + \sum_{K=1}^{3} \frac{-P_K}{F+T_K}, \tag{6}$$

where the vertical bars imply 'continued fractions,' that is

$$\sum_{K=1}^{3} \frac{-P_K}{F+T_K} = \cfrac{-P_1}{F+T_1 \cfrac{-P_2}{F+T_2 \cfrac{-P_3}{F+T_3}}}, \tag{7}$$

* NATLOG was supplied to NUSC by UNIVAX as part of the software package delivered with the 1230 computer.

** H. Maehly, Monthly Report, Institute for Advanced Study, Princeton, Oct 1956.

and $P_0 = 3.681656603$,

$P_1 = 34.41069291$,

$P_2 = 8.126503834$,

$P_3 = 0.2665195666$,

$T_1 = 10.37967214$,

$T_2 = 2.051212813$, and

$T_3 = 0.4249952497$.

Figure 2 is a flow diagram of "CONLOGIT" and Figure 3 is the flow chart of "NATLOG".

Program Usage

To use "CONLOGIT", the number X is put in the Q register, scaled to 15 bits. If X is negative, "CONLOGIT" sets it positive and proceeds, or if X is zero, an answer of -50.0 is given. If an error exit occurs in "NATLOG" caused by the scale factor S being outside of the limits, an answer of -100.0 is given. The answer, 10 $\log_{10}(X)$ will be in the Q register scaled 3 bits.

To call on "CONLOGIT", use the call "CONLOGIT" or use "RJP*CONLO

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APPENDIX A

LISTING OF "TENLOGTEN"

```
TENLOGTEN   ENTRY                   INPUT IN A SCALED 22D
            ENT*B7*LOGCOUNT         N GOES TO W(LOGCOUNT) ON NORM INSTRUCTION
            ENT*Q*0*APOS            PREPARE Q FOR NORMALIZATION
            JP*LOGERR               NEGATIVE INPUT
            JP*LOGERR*AZERO         INPUT WAS 0
            NORM*AQ*W(B7)           1 . GE . X . LT . 2
            SUB*A*2000000000        MINUS 1
            STR*A*W (LOGARG)
            ENT*B7*3
            ENT*Q*W(LOGCONT4)       B4
LOGLOOP     MUL*W(LOGARG)           EVALUATE POLYNOMIAL
            ADD*A*W(LOGCONTB7)      ADD COEFFICIENTS
            STR*A*Q                 SCALING IS 27,25,23,21 AS
            BJP*B7*LOGLOOP          B7 IS 3,2,1,0
            MUL*W(LOGARG)
            STRVA*W(LOGARG)         POLYNOMIAL
            ENT*Q*W(LOGCOUNT)       N
            SUB*Q*6                 N-6
            MUL*W(LOGCONT5)         (N-6)(-3.0102)
            ADD*Q*W(LOGARG)*QPOS    PLUS POLYNOMIAL
            SUB*Q*100000*SKIP       ROUND OFF
            ADD*Q*100000
            RSH*Q*16D*SKIP          SCALE TO 3 PLACES
LOGERR      ENT*Q*4000000000        ERROR VALUE
            EXIT                    OUTPUT IN Q SCALED 3
LOGCON      DATA*4 . 3407541D,21D
            DATA*-2 . 1363335D,23D
            DATA*1 . 2571730D,25D
            DATA*-.59091302D,27D
            DATA*.13966237D,29D
            DATA*-3 . 0102D,19D
LOGARG      0
LOGCOUNT    0
```

APPENDIX B

LISTING OF "CONLOGIT"

```
            PROCEDURE*CONLOGIT
            STR*Q*A*APOS          IS NUMBER NEGATIVE
            CP*Q                  YES, COMPLEMENT
            JP*CL4*AZERO          IF ZERO, JUMP TO CL4
            STR*B7*L(CL7)         SAVE B7
            ENT*B7*1              INITIALIZE COUNTER
CL2         LSH*Q*1               CHECK FOR POSSIBLE SCALE DOWN
            JP*CL3*QNEG           SCALE DOWN REQUIRED, JUMP TO CL3
            BSK*B7*13D            ALL OVERFLOW VALUES CHECKED?
            JP*CL2                NO
            JP*CL5                NUMBER WITHIN RANGE
CL3         ENT*B7*B7-13D         SET SCALE FACTOR
            STR*B7*CPL(167)       MAKE POSITIVE
CL5         ENT*Q*X(B7-15D)       SET NEW SCALE FACTOR
            CP*Q                  MAKE POSITIVE
            RSH*A*B7              RESET INPUT VALUE IN A
CL1         RJP*NATLOG            COMPUTE  NATURAL LOG
            JP*CL6                ERROR EXIT FROM NATLOG
            RSH*AQ*30D            NAT LOG IN Q SC=24D BITS
            MUL*33626754          CONVERT TO COM LOG SC=18D
            RSH*AQ*36D            COM LOG IN Q SC=12D BITS
            MUL*12                CONVERT TO 10 log (db)
            ADD*Q*400*APOS        ROUND OFF POSITIVE NUMBER
            SUB*Q*4000            ROUND OFF NEGATIVE NUMBER
            RSH*Q*9D*SKIP         SC=3 BITS
CL6         ENT*Q*X76337          ERROR, SET ANS TO -100.0db
CL7         ENT*B7*0              RESTORE B7
            RETURN                EXIT
CL4         ENT*Q*X77157          -50.0 IF NUMBER=0
            JP*L(CONLOGIT)        EXIT
            END-PROC*CONLOGIT
```

APPENDIX C

LISTING OF "NATLOG"

```
NATLOG      JP*O                        ENTRANCE
            STR*Q*CPW(KITTY)            COMPLEMENT, SAVE SCALE FACTOR
            CL*Q                        CLEAR REGISTER
            ENT*A*A*APOS                IS NUMBER POSITIVE
            CP*A                        NO, COMPLEMENT
            RPT*29D
            LSH*A*1*ANEG                AND COUNT SHIFT
            JP*NAT2                     NUMBER IS ZERO
            STR*B7*L(NAT1)              SAVE COUNT
            LSH*A*W(KITTY+2)
NATI        ENT*Q*X(0)
            ADD*Q*W(KITTY)              ORIGINAL INPUT
            LSH*Q*3                     M SC 3 IN Q
            ADD*Q*4                     M+½ SC=3
            CL*A
            MUL*W(POOL)                 (M+½)LN2 SC=3+29D
            RSH*AQ*9D                   RIGHT TO SC-23D
            ENT*A*A*AZERO
            CP*A*ANOT                   IS A 0 or all 7's
            RPL*Y+1*L(NATLOG)*SKIP      YES
            JP*L(NATLOG)                ERROR EXIT
            STR*Q*W(KITTY+1)
            ENT*Q*W(KITTY+2)            F
            ENT*Y+Q*W(POOL3)            F+T3 SC=23D
            ENT*Y+Q*W(POOL3)            F+T3 SC=23D
            STR*A*W(KITTY+3)
            ENT*Y+Q*W(POOL2)            F+T2 SC=23D
            STR*A*W(KITTY+4)
            ENT*Y+Q*W(POOL1)            F+T1 SC=23D
            STR*A*W(KITTY+5)
            ENT*Q*W(POOL3+1)            -P3 SC=23D
            ENT*A*X77777                SET SIGN
            LSH*AQ*23D                  ADJUST SC TO 46D
            DIV*W(KITTY+3)
            RPL*7+Q*W(KITTY+4)          SAVE FOR NEXT CONTINUED FRACTION
            ENT*Q*W(POOL2+1)            -P2 SC=23D
            ENT*A*X77777                SET SIGN
            LSH*AQ*23D                  ADJUST SC TO 46D
            DIV*W(KITTY+4)
            RPL*Y+Q*W(KITTY+5)          SAVE FOR NEXT CONTINUED FRACTION
            ENT*Q*W(POOL1+1)            -P1 SC=23D
            ENT*A*X77777                SET SIGN
            LSH*AQ*23D                  ADJUST SC TO 46D
            DIV*W(KITTY+5)
            ADD*Q*W(KITTY+1)
            ENT*Y+Q*W(POOL+1)           ANSWER
            LSH*A*1                     SCALE ANSWER TO 24D BITS
```

	JP*L(NATLOG)	NORMAL EXIT
POOL	2613441377	LN(2) SC=29D
	0165640206	P0 SC=23D
POOL3	0015463077	T3 SC=23D
	7767361257	-P3 SC=23D
POOL2	0101507044	T2 SC=23D
	7373747270	-P2 SC-23D
POOL1	0514114431	T1 SC-23D
	5662667151	-P1 SC=23D
KITTY	RESERVE 6	

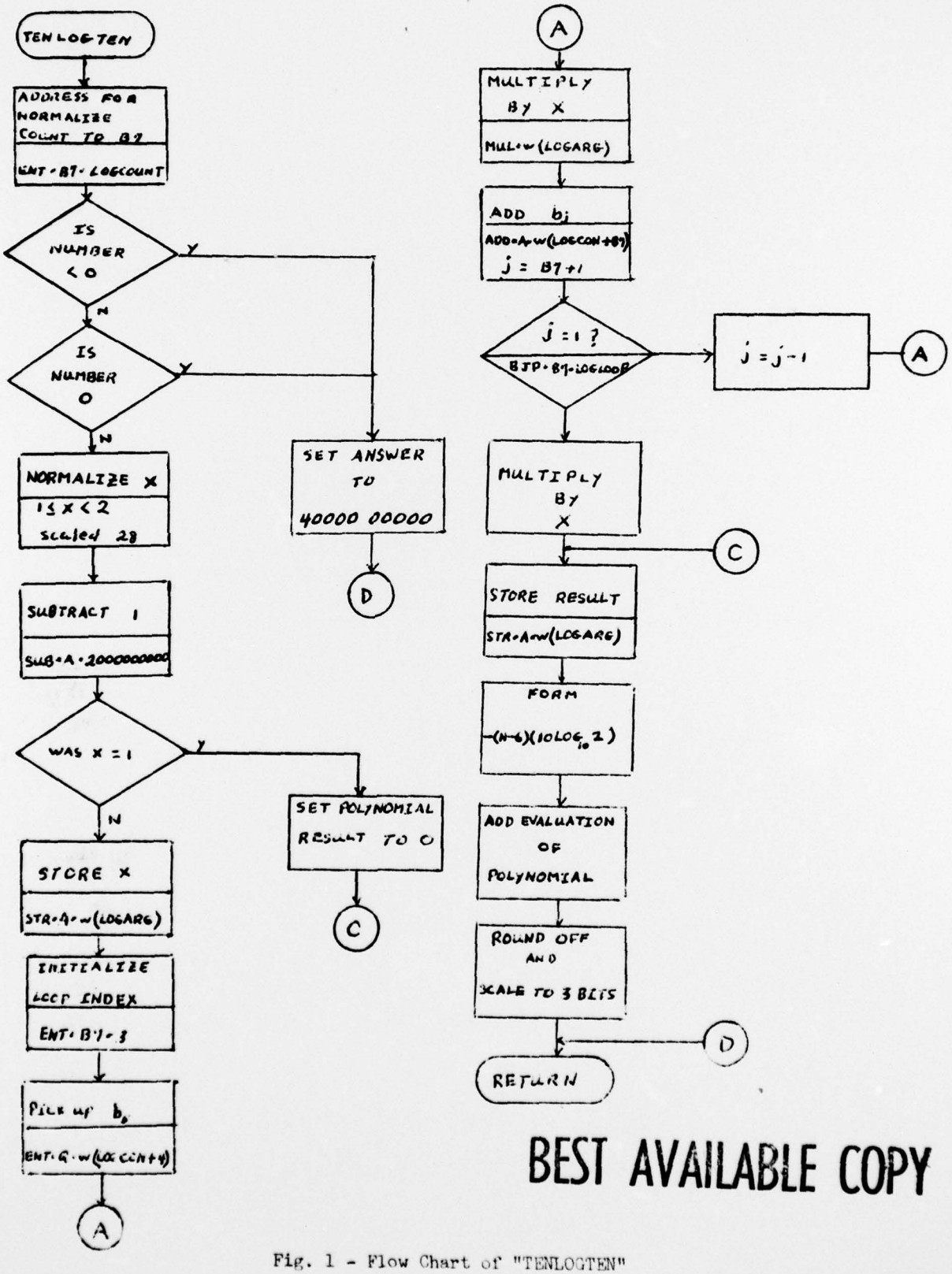

Fig. 1 - Flow Chart of "TENLOGTEN"

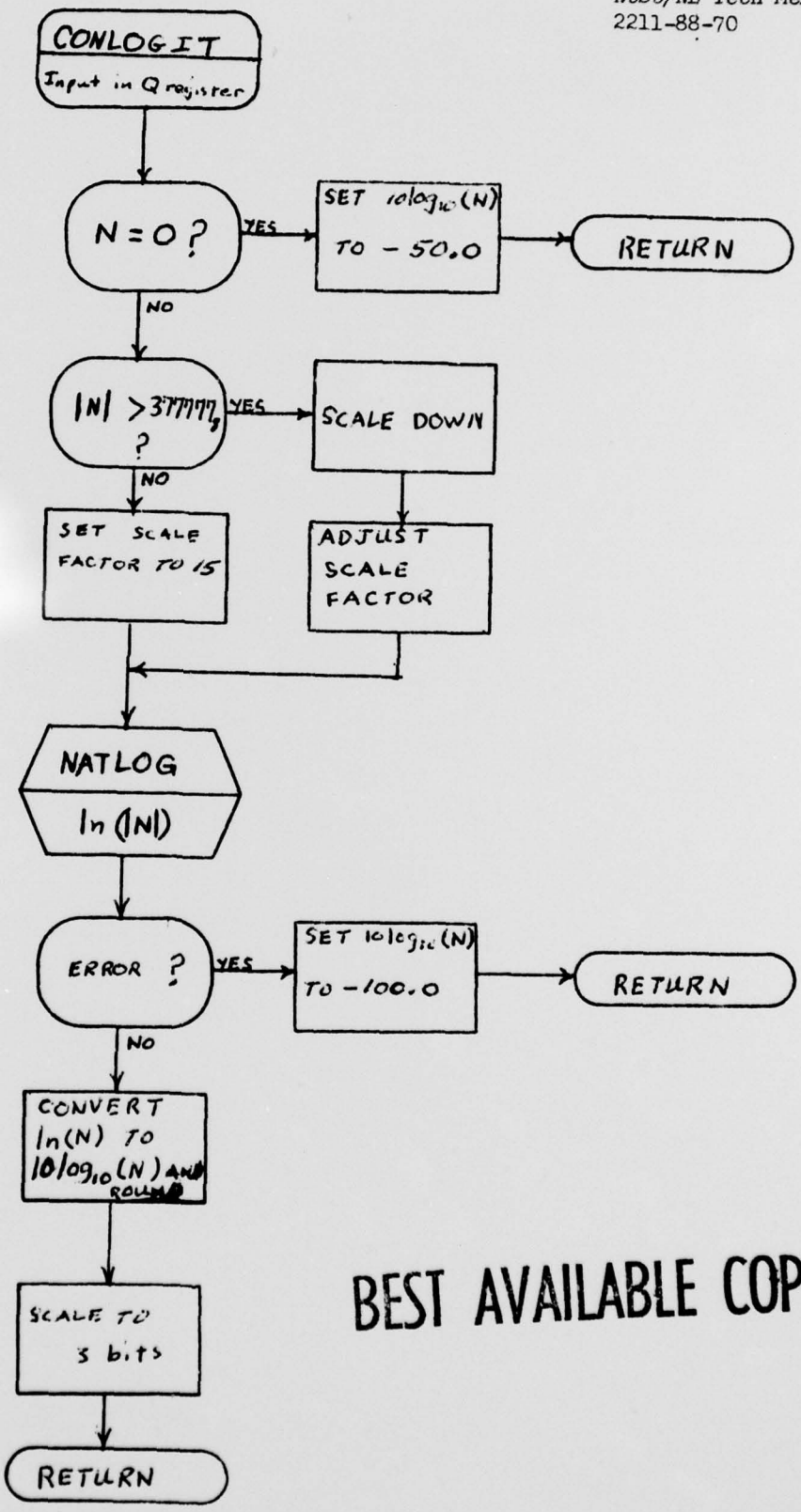

Fig. 2 - FLOW DIAGRAM OF CONLOGIT

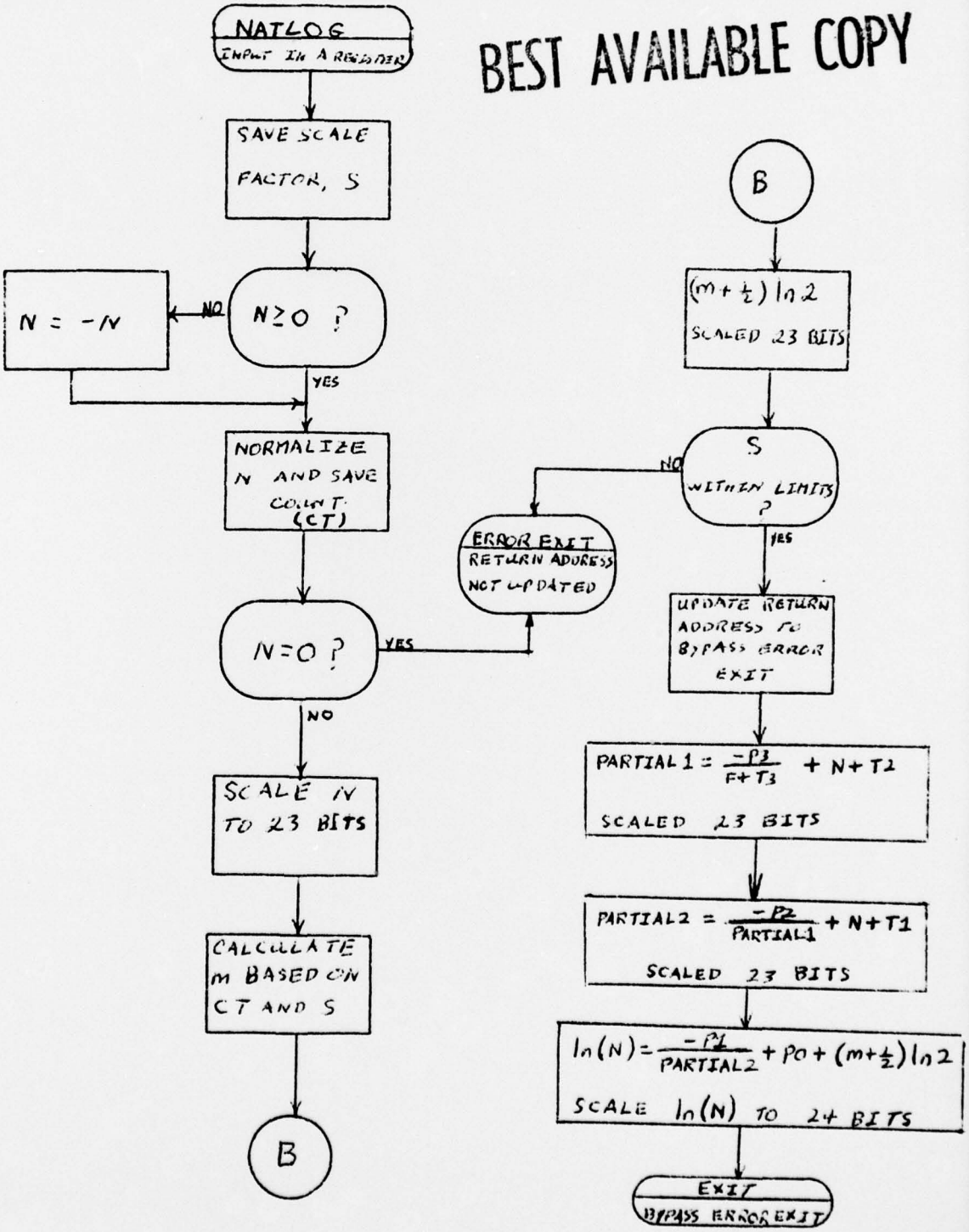

Fig. 3 - FLOW DIAGRAM OF NATLOG