1. IDENTIFICATION

1.1 Digital-8-25-U-Sym

1.2 Signed Decimal Print, Double Precision

1.3 January 19, 1966
2. ABSTRACT

This subroutine permits the typeout of the contents of two consecutive computer words as one signed, double-precision, twos complement number. If bit 0 of the high order word is a "1," the remaining 23 bits represent a negative integer in twos complement form; if bit 0 equals "0," the remaining bits represent a positive integer. If the number is negative, a minus sign is printed; if positive, space.

3. REQUIREMENTS

3.1 Storage
This subroutine requires 86 core locations.

3.2 Subprograms and/or Subroutine (None)

3.3 Equipment
Basic PDP-8 with ASR-33

4. USAGE

4.1 Loading
The symbolic tape provided is in PAL III or MACRO-8 language. It may be assembled with the user's program or separately with the proper origin setting. Neither origin setting nor "$" terminating character exists on the symbolic tape provided, but a PAUSE pseudo-instruction is the last line on tape.

4.2 Calling Sequence
The subroutine is called by an effective JMS SDPRNT. The location immediately following the calling JMS contains the address of the high-order portion of the signed, double-precision integer which is stored in the usual double-precision format.

5. RESTRICTIONS (None)

6. DESCRIPTION

6.1 Discussion
This is a basic subroutine to obtain signed, decimal output corresponding to a double-precision binary word storage in two consecutive locations in memory. First, the binary number is sensed to determine if it is positive or negative. If positive, a space is printed. If negative, a minus sign is printed, and the number complemented to form the absolute value. Then the same algorithm is followed as in the unsigned double-precision printout (Digital-8-24-U-Sym).

6.2 Examples and/or Applications (None)

6.3 Scaling
The numbers are interpreted and typed out as integers.

7. METHOD (See Digital-8-24-U)
8. FORMAT

8.1 Input Data (Not Applicable)

8.2 Core Data
The double precision integers are stored in the usual signed, double-precision format, (see Digital-8-13-F-Sym).

8.3 Output Data
Output is in the form of seven consecutive decimal digits preceded by either a space or a minus sign. Spacing, tabulation, carriage return, etc., are not provided in this subroutine. See Digital-8-19-U-Sym which contains subroutines for these purposes. If the user wishes to print a "+" sign instead of a space he may change the contents of location SDPLUS from "−15" to "−2".

9. EXECUTION TIME

9.1 Minimum

9.2 Maximum

9.3 Average
This subroutine is output limited at 10 cps by the ASR-33.

10. PROGRAM

10.1 Core Map (None)

10.2 Dimension List(s) (None)

10.3 Macro, Parameter, and Variable Lists (None)

10.4 Program Listing

/CHECK-OUT PROGRAM FOR SIGNED, DOUBLE-PRECISION PRINT(POSITIVE NUMBERS)
*200
RETURN=JMS TYCR
PRINT=JMS SDPRINT
SPACE=JMS TYSP

DEFINE DBLADD A B
<CLA CLL; TAD A+1; TAD B+1; DCA A+1; RAL; TAD A; TAD B; DCA A>

DEFINE DSHFT C D
<CLA CLL; TAD C; RAL; DCA C; TAD D; RAL; DCA D>

DEFINE DMOVE E F
<CLA; TAD E; DCA F; TAD E+1; DCA F+1>

INITL, RETURN
CLA CLL
DCA TEMP
DCA TEMP+1
TAD (-5)
DCA COUNT1
TAD (-2)
DCA COUNT2
RETURN

TOP,
PRINT; DNUMB
SPACE
DBLADD DNUMB, VARCON
ISZ COUNT1
JMP TOP

FIVE,
RETURN
TAD (-5)
DCA COUNT1
ISZ COUNT2
JMP TOP
TAD (-2)
DCA COUNT2
DMOVE VARCON, TEMP
DSHFT VARCON+1, VARCON
DSHFT VARCON+1, VARCON
DBLADD VARCON, TEMP
DSHFT VARCON+1, VARCON
DMOVE VARCON, DNUMB
JMP TOP

TEMP, DUBL 0
DNUMB, DUBL 0
VARCON, DUBL 1
COUNT1, 0
COUNT2, 0
PAGE
PAUSE

/ CHECK-OUT PROGRAM FOR SIGNED DOUBLE-PRECISION PRINT (NEGATIVE NUMBERS) *
*200
RETURN=JMS TYCR
PRINT=JMS SDPRINT
SPACE=JMS TYSCT

DEFINE DBLADD A B
<CLA CLL; TAD A+1; TAD B+1; DCA A+1; RAL; TAD A; TAD B; DCA A>

DEFINE DSHIFT C D
<CLA CLL; TAD C; RAL; DCA C; TAD D; RAL; DCA D>

DEFINE DMOVE E F
<CLA TAD E; DCA F; TAD E+1; DCA F+1>

DEFINE DBLSUB G H TE
<CLA CLL; TAD H; CMA; DCA TE; TAD H+1; CIA CLL; SZL; ISZ TE; NOP
CLL; TAD G+1; DCA G+1; RAL; TAD G; TAD TE; DCA G>
Control Program (modified*)

INITL
  RETURN
  CLA CLL
  DCA TEMP
  DCA TEMP+1
  TAD (-5)
  DCA COUNT1
  TAD (-2)
  DCA COUNT2
  RETURN

TOP
  PRINT; DNUMB
  SPACE
  DBLSUB DNUMB, VARCON, TEM

ARCON
  ISZ COUNT1
  JMP TOP

FIVE
  RETURN
  TAD (-5)
  DCA COUNT1
  ISZ COUNT2
  JMP TOP
  TAD (-2)
  DCA COUNT2
  DMOVE VARCON, TEMP
  DSHFT VARCON+1,VARCON
  DSHFT VARCON+1,VARCON
  DBLADD VARCON,TEMP
  DSHFT VARCON+1,VARCON
  DMOVE VARCON, DNUMB
  JMP TOP

TEMP, DUBL 0
DNUMB, DUBL 0
VARCON, DUBL -1
COUNT1, 0
COUNT2, 0
TEM, 0

PAGE
PAUSE

/SIGNED DECIMAL PRINT, DOUBLE PRECISION
/CALLING SEQUENCE:  JMS SDPRNT /SUBROUTINE CALLED
/  HIADDR  /ADDRESS OF HIGH ORDER WORD
/  RETURN  /RETURN WITH AC AND L CLEAR

SDPRNT, 0
  CLA CLL
  TAD I SDPRNT /PICK UP ADDRESS OF HIGH-ORDER WORD
  DCA SDGET
  TAD I SDGET /PICK UP HIGH-ORDER WORD
  SMA CLA /IS IT NEGATIVE?
  TAD SDPLUS /NO, GENERATE CODE FOR SPACE
  TAD SDMNS /YES, GENERATE CODE FOR "MINUS"
  JMS SDTYPE /TYPE IT OUT
  TAD I SDGET /PICK UP HIGH-ORDER WORD AGAIN
  SPA /IS IT POSITIVE?

*Modifications made on this Macro in check-out.
Signed Double Precision Print-out Positive Numbers

\[ 0000000 \quad 0000001 \quad 0000002 \quad 0000003 \quad 0000004 \\
0000005 \quad 0000006 \quad 0000007 \quad 0000008 \quad 0000009 \\
0000010 \quad 0000020 \quad 0000030 \quad 0000040 \quad 0000050 \\
0000060 \quad 0000070 \quad 0000080 \quad 0000090 \quad 0000100 \\
0000110 \quad 0000120 \quad 0000130 \quad 0000140 \quad 0000150 \\
0000200 \quad 0000300 \quad 0000400 \quad 0000500 \quad 0000600 \\
0001000 \quad 0002000 \quad 0003000 \quad 0004000 \quad 0005000 \\
0006000 \quad 0007000 \quad 0008000 \quad 0009000 \quad 0010000 \\
0100000 \quad 2000000 \quad 3000000 \quad 4000000 \quad 5000000 \\
6000000 \quad 7000000 \quad 8000000 \quad -7777216 \quad -6777216 \\
-6777 \\
\]

Double Precision Print-out Negative Numbers

\[ -0000000 \quad -0000001 \quad -0000002 \quad -0000003 \quad -0000004 \\
-0000005 \quad -0000006 \quad -0000007 \quad -0000008 \quad -0000009 \\
-0000010 \quad -0000020 \quad -0000030 \quad -0000040 \quad -0000050 \\
-0000060 \quad -0000070 \quad -0000080 \quad -0000090 \quad -0000100 \\
-0000110 \quad -0000120 \quad -0000130 \quad -0000140 \quad -0000150 \\
-0000200 \quad -0000300 \quad -0000400 \quad -0000500 \quad -0000600 \\
-0001000 \quad -0002000 \quad -0003000 \quad -0004000 \quad -0005000 \\
-0006000 \quad -0007000 \quad -0008000 \quad -0009000 \quad -0100000 \\
-0100000 \quad -0200000 \quad -0300000 \quad -0400000 \quad -0500000 \\
-0600000 \quad -0700000 \quad -0800000 \quad -0900000 \quad -1000000 \\
-1000000 \quad -2000000 \quad -3000000 \quad -4000000 \quad -5000000 \\
-6000000 \quad -7000000 \quad -8000000 \quad -7777216 \quad -6777216 \\
6777216 \quad -3222784 \quad 355 \]
CMA CML  /NO, COMPLEMENT IT. SET LINK
DCA SDHIGH  /STORE POSITIVE WORD FOR USE IN SUBROUTINE
ISZ SDGET  
PICK UP LOW-ORDER WORD
TAD I SDGET  /IS LINK SET?
SZL  
CMA CLL IAC  /YES, FORM TWO'S COMPLEMENT
SZL  /DID AC OVERFLOW FROM "IAC"?
ISZ SDHIGH  /YES, CORRECT HIGH-ORDER WORD
DCA SDLow  /STORE POSITIVE LOW-ORDER WORD
TAD SDLoop  /INITIALIZE DIGIT COUNTER TO "1"
DCA SDCNT  
TAD SDDAR  /INITIALIZE POINTER TO TABLE OF POWERS
DCA SDPTR  
ISZ SDPANT  /INDEX LINKAGE FOR CORRECT RETURN
TAD I SDPTR  /PICK UP POWER OF TEN FOR USE IN SUBTRAG
ISZ SDPTR  
DCA SDHSUB  
TAD I SDPTR  
ISZ SDPTR  
DCA SDLow  
TAD SDHSUB  
DCA SDLSUB  

SDDO,  

CLL  /DOUBLE PRECISION SUBTRACTION
TAD SDLSUB  
TAD SDLow  
DCA SDEML  
RAl  
TAD SDHSUB  
TAD SDHIGH  
SPA  /DID IT UNDERFLOW?
JMp SDOUT  /NO, COUNT IS DONE
ISZ SDBOX  /YES, COUNT NOT DONE. INDEX DIGIT
DCA SDHIGH  /DEPOSIT REMAINING HIGH-ORDER PORTION
TAD SDEML  /RESTORE REMAINING LOW-ORDER PORTION
DCA SDLow  
JMp SDDO  /GO BACK AND SUBTRACT AGAIN

SDOUT,  

CLA  /PICK UP RESULTING DIGIT
TAD SDBOX  /TYPE IT OUT
JMS SDTYPE  /INITIALIZE DIGIT TO "0"
DCA SDBox  
ISZ SDCNT  /HAVE WE TYPED "7" DIGITS
JMp SDDRND  /NO, DETERMINE NEXT DIGIT
JMp I SDPRNT  /YES, SUBROUTINE DONE. RETURN

SDTYPE, 0  /TYPEOUT ROUTINE
TAD SDTWo  
TLS  
TSF  
JMp -1  
CLA CLL  
JMp I SDTYPE  

SDLOOP, -7  /COUNT OF SEVEN DIGITS
SDADDR, SDCONL  /INITIAL ADDRESS OF POWERS OF TEN
SDTWO, 260  /BASIC CODE FOR DIGITS
SDPLUS, -15  /"SPACE". TO TYPE "+", REPLACE BY "-2"
SDMIN, 3  /"MINUS"
SDCNT, 0  
SDHIGH, 0  
SDLow, 0  
SDHSUB, 0  /STORAGE LOCATIONS
| SDL SUB, | 0 |
| SDL DX, | 0 |
| SDL EMU, | 0 |
| SDL DT, | 0 |
| SDL PTR, | 0 |
| SDL ONL, | 7413 |
| 6700 | /-1,000,000 |
| 7747 | /-100,000 |
| 4540 | /-10,000 |
| 7775 | /-1,000 |
| 4360 | /-100 |
| 7777 | /-10 |
| 6030 | /-1 |
| 7777 | /-1 |

**TABLE OF POWERS OF TEN**
11. DIAGRAMS

11.1 Flow Chart

(entry)

pick up address of high-order word

pick up double precision number for use in subroutine

initialize counters and pointers

pick up current power of ten

index digit

perform double precision subtract from number

index to pick up next power of ten, put digit count to zero

yes

did it underflow?

no

store remaining portion of double precision number

pick up generated digit
type it out

have 7 digits been typed out?

no

yes

subroutine finished

exit
12. REFERENCES

12.1 Other Library Programs

Digital-8-13-F-Sym
Digital-8-19-U-Sym
Digital-8-24-U-Sym