

April 22, 1958

FILE MEMO

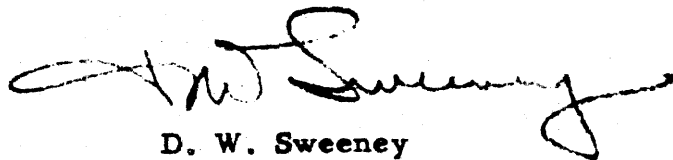
SUBJECT: Floating Point Multiple Precision Routines

Programs are attached which show the effectiveness of Stretch in doing double and triple precision arithmetic. (This gives the equivalent of 28-29 or 43-44 decimal digits.)

As was expected, the double precision routines were extremely straightforward and easy to program since the double precision accumulator eliminates most coupling effects between high and low order portions which ordinarily must be programmed.

The triple precision programs were written to see what was required when the coupling effects had to be considered. Even in these cases the programs are fairly simple compared to other computers in which this type of routine has to be interpretively coded in fixed point and then converted back to floating point. The operation, Store With Borrow, was originally conceived as a requirement for multiple precision addition to afford coupling facility but it was found unnecessary with the present configuration and it is recommended that it be dropped.

Note that no attempt was made to guarantee the accuracy of the lowest order bits. To do this requires doing arithmetic of almost the next higher precision. For example, to guarantee the low order bit in single precision requires almost the work of double precision.



D. W. Sweeney  
Product Planning Coordinator  
Project 7000

DWS/jcv

cc: 7000 Product Planning  
7000 Engineering Planning  
Mr. E. H. Bloch  
Mr. L. G. Allen  
Mr. H. G. Jones  
Mr. G. T. Paul  
Mr. S. G. Campbell

Coche

Double Precision

APPLICATION: ADD, MULTIPLY, and DIVIDE PAGE 1

DATE-INITIALS:

4/22/58  
TWS

LOCATION	CL	OP	M	CI	ADDRESS	X	J	ADDRESS				X	REMARKS
								PX	I	L	B		
<b>ADD</b>													These routines assume one operand in the accumulator, the other is in storage (K, L), and the result is left in the accumulator.
d+0	N	AD	S		L								
d+1	N	AD	S		K								
<b>MULTIPLY</b>													
d+0	N	LCMD	S		A register								
d+1	U	SLO	S		A register								
d+2	U	MPYD	S		K								
d+3	N	MPYC	S		L								
d+4	N	MPYC	S		K								
<b>DIVIDE</b>													
d+0	N	DIVD	S		K								
d+1	N	S	S		M register								
d+2	N	MPYD	N		K								
d+3	N	AD	S		R register								
d+4	N	DIVD	S		K								
d+5	N	AD	S		M register								

# Double Precision

APPLICATION: ADD, MULTIPLY, and DIVIDE PAGE 2

DATE-INITIALS: 4/2/58  
DWS

LOCATION	CL	OP	M	CI	ADDRESS	X	J	ADDRESS				X	REMARKS
								PX	L	B	OF		
<b>ADD</b>													<i>These routines assume operands in storage (F,G) and (K,L) with the result in storage (R,S)</i>
α+0	U	LD	S		G								
1	N	AD	S		L								
2	N	AD	S		F								
3	N	AD	S		K								
4	U	S	S		R								
5	U	SLO	S		S								
<b>MULTIPLY</b>													
α+0	U	L	S		G								
1	U	MPYD	S		K								
2	U	LCMD	S		F								
3	N	MPYC	S		L								
4	N	MPYC	S		K								
5	U	S	S		R								
6	U	SLO	S		S								
<b>DIVIDE</b>													
	U	LD	S		F								
	N	AD	S		G								
	N	DIVD	S		K								
	N	S	S		R								
	N	MPYD	N		L								
	N	AD	S		Registers								
	N	DIVD	S		K								
	N	AD	S		R								
	U	S	S		R								
	U	SLO	S		S								

LOCATION	CL	OP	M	CI	ADDRESS	X	J	ADDRESS			X	REMARKS
								PX	L	BI OF		
0+0	V	L	PAB		F							The operands are (F,G,H) and (K,L,M). The result replaces (F,G,H)
1	V	H	NAB		K							
2		BIN	FL	M	0+4							
3	I	SWP	F		F			K			3	
4		BIN	NL	PSH	0+24							
5	V	LD	S		F							
6	N	AD	S		K							
7		BIN	NL	Z	0+27							
8	V	S	S		F							
9	V	SLO	S		K							
10	V	LD	S		M							
11	N	AD	S		H							
12	N	AD	S		L							
13	N	AD	S		G							
14	N	AD	S		K							
15	V	SLO	S		H							
16	V	AD	N		H							
17	N	AD	S		F							
18	N	S	S		F							
19	V	SLO	S		G							
20	V	LD	S		G							
21	V	AD	S		H							
22	V	S	S		G							
23	V	SLO	S		H							end of routine
24	V	LD	S		K							
25	V	SLO	S		K							
26		B			0+11							
27	V	SLO	S		F							
28		B			0+9							

APPLICATION:

Triple Precision  
MULTIPLY

PAGE: 4

DATE-INITIALS:

4/22/58  
TMS

LOCATION	CL	OP	M	CI	ADDRESS	X	J	ADDRESS				X	REMARKS	
								FX	L	B	OF			
070	U	L	S		F									
1	U	LCMD	S		F									
2	N	MPYD	S		K									
3	N	S	S		F									
4	U	SLO	S		Register									
5	U	L	S		H									
6	U	MPYD	S		K									
7	N	MPYC	S		M									
8	N	MPYC	S		L									
9	U	LCMD	S		G									
10	N	MPYC	S		L									
11	N	MPYC	S		K									
12	N	A-D	S		Register									
13	U	SLO	S		H									
14	U	A-D	N		H									
15	N	A-D	S		F									
16	N	S	S		F									
17	U	SLO	S		G									
18	U	LD	S		G									
19	U	A-D	S		H									
20	U	S	S		G									
21	U	SLO	S		H									

The operands are  
(E,G,H) and (K,L,M).  
The result replaces  
(E,G,H)

APPLICATION:

*Triple Precision*  
**DIVIDE**

PAGE: *5*

DATE-INITIALS:

*4/22/58*  
*T.D.S.*

LOCATION	CL	OP	M	CI	ADDRESS	X	J	ADDRESS				X	REMARKS
								PX	L	B	OF		
0+0	U	LD	S		F								<i>The operands are (F,G,H) and (K,L,M). The result replaces (F,G,H).</i>
1	U	AD	S		G								
2	N	DIVD	S		K								
3	N	S	S		F								
4	U	MPYD	N		L								
5	N	AD	S		<i>Register</i>								
6	N	DIVD	S		K								
7	U	S	S		G								
8	U	MPYD	N		L								
9	U	LCMD	N		F								
10	N	MPYC	S		M								
11	N	AD	S		<i>Register</i>								
12	N	DIVD	S		K								
13	N	AD	S		G								
14	U	SLO	S		H								
15	U	AD	N		H								
16	N	AD	N		F								
17	N	S	S		F								
18	U	SLO	S		G								
19	U	LD	S		G								
20	U	AD	S		H								
21	U	S	S		G								
22	U	SLO	S		H								