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Floating Point Interpretive System 6

TITLE: Multiply Regression Floating Point System

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ABSTRACT:

This floating point interpretive routine occupies 15 tracks of memory and includes floating point arithmetic, 6-bit floating point data input, an automatic tracing mode and the ERFP data output (Program 12.5). Data and word structure consists of 30 binary bits for fraction and nine binary bits for exponent. The command structure consists of 9 arithmetic operations, 2 input orders, 2 print orders, 2 stop orders, 2 logical and transfer orders and 2 exit orders.

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Program Description

Multiple Regression Floating Point System

Section I - Function

The purpose of this floating point interpretive system is to cause the LGP-30 to act as a floating point computer. Since the program was essentially written for use in a multiple regression routine,* it is not a complete interpretive system in the usual sense. The arithmetic and housekeeping operations (with the exception of the N order) have the same meaning as in fixed point operation. To assist the programmer in debugging his programs, automatic tracing of the problem-program is available upon depression of the transfer control switch. A modified tracing mode is available by the change of one instruction.

Section II - Number Format

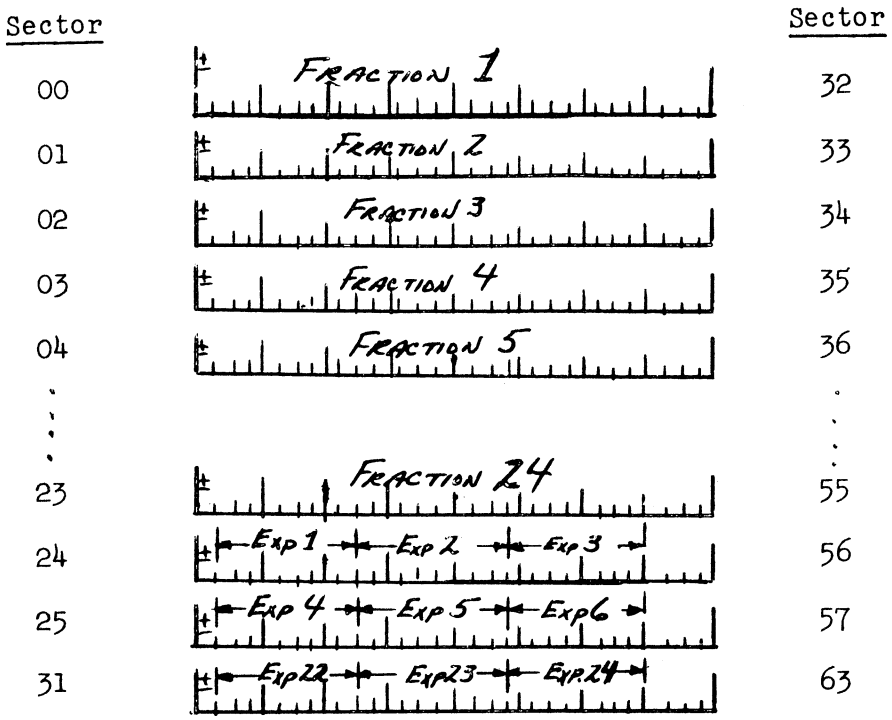
1. Floating Point Accumulator

A number in the floating point accumulator occupies two words of memory. One word consists of 31 binary bits representing the sign and magnitude of the fraction. This is a fully normalized number with a bit always in the most significant part of the word if positive and no bit if negative. The fractional part of the number is located in 0042. The second word consists of the exponent carried at q = 29 with an excess of 256 at 29 and is stored in location 0041. Thus a number whose real exponent is 12 at 29 will be represented as (256 + 12) = 268 at 29 and a number whose real q = -4 will be represented as (256 - 4) = 252 at 29. The number zero is represented as zero fraction and zero exponent.

2. Format in Memory

A floating point number in memory consists of two words -- one word representing the fractional portion and a second word representing the exponent. As in the case of the floating point accumulator, the fraction is a fully normalized 30 bits in addition to the sign bit. The exponents consist of nine bits each stored with three exponents per word again using the excess 256 form. Since the program was originally written for matrix operations, the following method of storing fractions and the corresponding exponents was adopted: The memory was considered to be constructed of elements each containing one-half track of memory. Hence in each half track, 24 words are used to store fractions and 8 to store the exponents for these fractions. The following figure indicates how this storage is arranged in memory.

* POOL Program F2-122



The procedure for generating the address of the exponent from the address of the fraction is as follows:

a. Save track bits and 32 bits of sector. Call this quantity T'. Call the five remaining bits of the sector portion of the address S'.

b. Divide S' by 3, saving the integer portion, I, and the remainder, F.

c. Add T' + 24 to I. This gives the address of the exponent.

d. Multiple F by 3. This tells which of the three exponents in the word is to be used.

Precautionary Note: This program will operate correctly only with sector addresses of 00-23 and 32-55. No check is provided for illegal addresses. Care should be taken that illegal addresses are not used, either by direct specification or address modification.

Section III - Order Structure

A total of 19 orders is available to the programmer. The term "accumulator" refers to the floating point accumulator described in Section II, Part 1.

A. Arithmetic Instructions

1. B XXXX Bring

The contents of XXXX replace the contents of the accumulator.

2. H XXXX Hold

Store the contents of the accumulator into XXXX.

3. C XXXX Clear

Store the contents of the accumulator into XXXX and set the accumulator to zero.

4. A XXXX Add

The contents of XXXX added to the contents of the accumulator replace the contents of the accumulator.

5. S XXXX Subtract

The contents of XXXX subtracted from the contents of the accumulator replace the contents of the accumulator.

6. M XXXX Multiply

The contents of XXXX multiplied by the contents of the accumulator replace the contents of the accumulator.

7. D XXXX Divide

The contents of the accumulator divided by the contents of XXXX replace the contents of the accumulator.

8. R 0000 Square Root

The square root of the contents (if non-negative) of the accumulator replace the contents of the accumulator. The address portion of the word has no meaning. Thus R 1234 will still mean take the square root of the accumulator.

9. Y 0000 Change Sign

The contents of the accumulator multiplied by a minus one replace the contents of the accumulator. The address portion of the word has no meaning.

B. Output Instructions

10. P 0000 Print Accumulator

Print the contents of the accumulator in floating point format. The ERFP output is used. A short format discussion is given below. If the reader needs further details, it is recommended he consult the ERFP write-up. The contents of the accumulator are not disturbed.

Output will consist of a decimal point followed by 8 decimal digits of the fraction and the sign of the fraction. (The sign will be either "minus" or a "space"). Following this will be two spaces and a two-digit exponent to the base 10 and its sign (only printed if "minus").

Examples of Output:

Printed Output	Number in Power of Ten System	Numerical Value
.50600000 - 04	$-.506 \times 10^{4}$	-5060.0000
.12345678 03	$.12345678 \times 10^{3}$	123.45678
.50000000 07-	$.5 \times 10^{-7}$	.00000005

A convenient rule to convert numbers in floating point format to their numerical value is to move the decimal point to the right the number of places indicated by the exponent, if the sign of the exponent is positive and to the left, if the sign of the exponent is negative.

11. P XXXX Print Character

If XXXX is non-zero, the print instruction indicated by XXXX will be executed. A delay is supplied by the interpretive routine.

C. Transfer Orders

12. T XXXX Test

If the sign of the accumulator is negative, the next interpreted instruction will be taken from XXXX; otherwise the interpretation continues in succession.

13. U XXXX Unconditional Transfer

The next instruction to be interpreted will be taken from XXXX. This order cannot be used to exit from the floating point system.

D. Stop Orders

14. Z 0000 Stop

Computation is halted unless Breakpoint 4 is depressed. The location of the Z 0000 order appears in the real accumulator at the time the machine stops. Depressing START will cause computation to resume at the next successive instruction. The address portion of the instruction is ignored.

15. N 0000 Stop

The N order is interpreted in all respects similar to Z 0000.

E. Exit Orders

16. E 0000 Exit Sequentially

Exit from the floating point system. Control is returned to the next successive location.

17. E XXXX Exit and Transfer

Exit from the floating point system. Control is returned to XXXX.

F. Input Orders

18. I 0000 Input Sequentially

The I 0000 order causes control to be transferred to 6-bit data input subroutine. The input routine will function sequentially until a proper exit order is encountered. The next successive instruction will be interpreted. The last data word is in the floating point accumulator.

19. I XXXX Input Single Data Word

The I XXXX order will cause the data input routine to read a single data word into XXXX. Control will be returned to the interpreter for interpretation of the next successive instruction. The data word will be in the floating point accumulator.

See Section VI for tape preparation and format details.

Section IV - Address Modification

This interpretive system does not contain any provision for address modification within the system. Hence in order to modify addresses, it is necessary to exit from the system and execute these in machine language. Although this is somewhat inconvenient, it should be pointed out that address modification in fixed point will run at considerably faster speeds than interpreted address modification orders. A further consideration was the desire to keep the program as short as possible.

Section V - Function Evaluation

This system contains no function evaluation orders with the exception of the square root order.

Section VI - Data Input Routine

The data input routine for this system is a 6-bit data input routine coded as an integral part of the interpretive system. The 6-bit button must be depressed during reading of data.

Function:

The function of this routine is to input, convert, and store nine decimal digit numbers in the proper floating point form of this system. To allow for direct placing of the decimal point, the six-bit input mode is used. The routine is designed to read either groups of numbers into sequential locations (the I 0000 order) or to read a single data word into a specified location (the I XXXX order).

Input:

I 0000 - Input Sequentially

Three types of words are used by this order.

a. Initial address.
b. First half of number or "group" and "exit" instructional words.
c. Second half of number.

a. The initial address word is a 4-digit decimal address at which sequential storage is to begin. Sequential storing will continue until either an "EXIT" or "GROUP" word appears in the first half of the number.

b. The first half of the word can contain the following:

i. "EXIT" - The reading of the word "EXIT" will cause a carriage return to be executed and the routine to return to the next sequential interpretive order following I 0000 order.

ii. "GROUP" - The reading of the word "GROUP" will cause the routine to read a new initial address word.

iii. First half of number - The first half of a number can consist of five or less "acceptable" characters plus the minus sign if the number is negative. An "acceptable" character is defined as a decimal digit or the decimal point itself. If the number is positive, the positive sign must not be used. In the event that the number is negative, leading zeroes must be supplied. (See examples below.)

c. The second half of the word consists of five or less acceptable characters, as defined in paragraph iii. above.

Data Tape Preparation for I 0000 Order:

Any number containing nine decimal digits, plus the decimal point (and with a minus sign, if negative), is acceptable. These ten acceptable characters are read in two 5-character words.

Example: It is desired to place the following numbers into the specified locations.

Number	0.0	0.1435	768.976456	-0.000465712	100.0	100,000,000
Location	6200	6201	6202	6203	6220	6100

12.35	-4.0	.000000001	-60.00
6101	6102	6103	6250

DATA LOAD SHEET

Address Word	Stop	±	First Word	Stop	Second Word	Stop	
6200	'			'		'	
			.1435	'		'	
			768.9	'	76456	'	
		-	.0004	'	65712	'	
			GROUP	'			(Read New Address)
6220	'			'	100.	'	
			GROUP	'			(Read New Address)
6100	'		10000	'	0000.	'	
				'	12.35	'	
		-	4.000	'		'	
			.0000	'	0001	'	
			GROUP	'			(Read New Address)
6250	'	-	60.00	'		'	
			EXIT	'			(End of Input)

Note: Words consisting of all zeroes need not be punched. A Stop Code is sufficient. The number zero can be input by using two Stop Codes.

I XXXX - Input Single Word

This input order will read one word into location XXXX. Under this mode no initial address is given to the routine. Hence normally one would only punch the decimal data in accordance with the instructions given for the I 0000 order, omitting the initial address, group, and exit words. Thus to read the same data as in the previous example, the program shown below with the corresponding data tape punching will suffice.

Program		Data Tape
R (Lo)	Enter F.P.	
U (Lo)		
I 6200		''
I 6201		.1435''
I 6202		768.9'76456'
I 6203		-.0004'65711
I 6220		'100.'
I 6100		10000'0000.'
I 6101		'12.35'
I 6102		-4.000''
I 6103		.0000'00001'
I 6250		-60.00''

Special Note on Use of I XXXX: One exception to this rule is allowed. If one has an I XXXX order and wishes to change the location of storage, the first word should be "group". This is followed by the address into which the data word should be read. This, in turn, is followed by the desired data word. Thus, suppose the I XXXX reads I 2006 and it is desired to store a data word into 2114 instead. One would prepare tape as follows: group' 2114'XXX.X'XXXXX' It should be remembered that changing the data word location will not cause the input routine to enter the sequential mode of input.

Accuracy:

Integers are converted exactly.
Fractional numbers will be in error by less than 1 in the 29th bit regardless of relative position of decimal point.

It is immaterial to the accuracy of conversion as to the relative position of the decimal point. For example, the number 12.34 can be punched in any of the following ways.

12.34''	12.3'40000'	12.'34000'	12'.3400'
1'2.340'	'12.34'		

Similarly -12.34 can be punched as:

-12.34''	-012.3'40000'	-0012.'34000'	-00012'.34000'
-00001'2.340'		-00000'12.34'	

Note that leading zeroes must be supplied for the negative situation.

Time: Approximately 25 words/minute.

Method of Conversion:

To guarantee maximum accuracy in conversion of the number, a normalizing operation is used. After binarization at q = 30 is completed, a normalizing loop is entered (provided $N \neq 0$). Since N is a nine-digit number it must be $< 10^{9}$. The normalizing routine scales N such $8 \times 10^{7} \leq N < 10^{9}$, counting the number of multiplying shifts (by 10 at 31) required to do this. Call the number of left shifts R and the resulting shifted number N*. Having already determined P ($0 \leq P \leq 9$), N* is scaled by two successive divide operations -- one to account for $\overline{P}$, the decimal point location and the other to account for the R shifts. By this method, therefore, a number such as 0.1 will be accurately converted regardless of the position of the "." and "1" within the two words. If the significant characters are all placed in the first word, the R loop will not require as many iterations; hence the routine will require less time than if the significant characters are all placed in the second word. All numbers are standardized prior to storage. The number zero is represented as zero fraction and zero exponent.

Special Notes:

If the number consists of five or less characters (4 digits plus decimal point), the routine will load faster if these are in entirely the first word. The reason for this is discussed in the section on conversion method used.

The input routine uses certain sections of the interpretive routine to perform the data storage operation. This causes the contents of the accumulator to be replaced by the data word being read in. In the case of any interpreted input order, the floating point accumulator will contain the last data word read in.

Section VII - Tracing Mode

The floating point system of 12 tracks contains an automatic tracing mode. Tracing of all floating point instructions will be carried out upon depression of the transfer control switch. The tracing mode will print the absolute location of the instruction to be interpreted, the instruction itself, the contents of the memory location, (if an arithmetic instruction) and the contents of the floating point accumulator after the execution of all instructions with the exception of the exit orders. After printing the contents of the floating point accumulator, a carriage return is executed.

The following table illustrates the type of printing for each instruction.

Type of Command	Column A Location of Instruction	Column B Instruction	Column C Contents of Memory or F.P. Accumulator After Execution	Column D Contents of F.P. Acc. After Execution
B XXXX	YYYY	B XXXX	F.P. Accumulator	
H XXXX	YYYY	H XXXX	F.P. Accumulator	
C XXXX	YYYY	C XXXX	F.P. Accumulator	
A XXXX	YYYY	A XXXX	Contents of XXXX	Contents of F.P. Acc.
S XXXX	YYYY	S XXXX	Contents of XXXX	Contents of F.P. Acc.
M XXXX	YYYY	M XXXX	Contents of XXXX	Contents of F.P. Acc.
D XXXX	YYYY	D XXXX	Contents of XXXX	Contents of F.P. Acc.
R 0000	YYYY	R 0000	Contents of F.P. Acc.	
Y 0000	YYYY	Y 0000	Contents of F.P. Acc.	
P 0000	YYYY	P 0000	Contents of F.P. Acc.	Contents of F.P. Acc.
P XXXX	YYYY	P XXXX	Character and Contents of F.P. Accumulator	
T XXXX	YYYY	T XXXX	Contents of F.P. Acc.	
U XXXX	YYYY	U XXXX	Contents of F.P. Acc.	
Z 0000	YYYY	Z 0000	Contents of F.P. Acc.	
N 0000	YYYY	N 0000	Contents of F.P. Acc.	
E 0000	YYYY	E 0000	(No Print or Carr. Ret.)	
E XXXX	YYYY	E XXXX	(No Print or Carr. Ret.)	
I 0000	YYYY	I 0000	Upon recognition of the "EXIT" order, the contents of F.P. Acc. will be printed. This will be the last data word read in.	
I XXXX	YYYY	I XXXX	Contents of F.P. Acc.	(Data word read in)

Note: In the case of an E 0000 or E XXXX order, the trace routine does not have the opportunity to execute a carriage return. Hence the next traced instruction will appear on the same line as the previous exit order.

The tracing mode (which occupies one track) can be dropped from the program by the following changes in the program.

Location	Present Contents	New Contents	Notes
0007	800T1063	U0008	Eliminate Printing of Location and Instruction
0016	800T0718	U0000	Eliminate Printing of Floating Point Accumulator After Instruction Execution
0521 0522	R1447 U1300	R1347 U1200	Calling Sequence for ERFP Printing Subroutine

Loading Sequence

	Start Fill	Set Modifier
Interpreter and Input	;000 (Lo)	/000 (Lo)
ERFP Output	;000 (Lo + 1100)	/000 (Lo + 1100)

A further modification of the tracing mode can be made by dropping the last track of the interpreter and placing into location 0007 the new command U0008. With the transfer control switch down the contents of the floating point accumulator will be printed after the interpretation of each instruction.

Speed of Tracing

All fixed point commands are executed at full machine speed. The time required for tracing is essentially that of printing the desired information. One can expect tracing to be executed at the rate of approximately 6 seconds per traced instruction.

Section VIII - Miscellaneous Information

1. Loading Sequence with Trace

Routine	Start Fill	Set Modifier	Storage
Interpreter, Input & Trace	;000 (Lo)	/000 (Lo)	12 Tracks
ERFP Output (Prog. 12.5)	;000 (Lo + 1200)	/000 (Lo + 1200)	4 Tracks

Loading Sequence without Trace

Routine	Start Fill	Set Modifier	Storage
Interpreter and Input	;000 (Lo)	/000 (Lo)	11 Tracks
ERFP Output (Prog. 12.5)	;000 (Lo + 1100)	/000 (Lo + 1100)	4 Tracks

Note: See Section VII for program changes to allow omission of the tracing instructions.

2. Storage

12 Tracks with trace.

11 Tracks without trace.

Almost all Track 63 is used for temporary storage.

3. Calling Sequence

α R (Lo Interpreter)
$\alpha + 1$ U (Lo Interpreter)
$\alpha + 2$, $\alpha + 3$, $\alpha + 4$ } Floating Point Instructions

4. Program Stops

Location	Meaning	Corrective Action
Lo + 0261	Division by zero or unfloated number.	Do not continue.
Lo + 0315	$N > 2^{256}$ in Hold or Clear operation.	Do not continue. Pressing start will cause the floating point accumulator to be cleared. and the next instruction interpreted.
Lo + 0336	Z or N order Breakpoint 4	Press "Start" to continue. The real accumulator contains the location of the Stop order. To find the order itself, go into One Operation Mode. Press "Fill Instruction" button and then "Execute Instruction". The Stop Instruction will then be displayed in the real accumulator. To continue, go back to "Normal" and press "Start".
Lo + 0345	N negative in Square Root Order	Pressing start to continue will cause the floating point accumulator to be cleared and the next instruction interpreted.
Lo + 0725	Ten digits were read in by data input routine $N > 2^{30}$	Do not continue.

Time of Execution:

The times given in the table below are approximate and are somewhat on the conservative side.

Order	Time of Execution
Z 0000	145 ms
B XXXX	300 ms
Y 0000	150 ms
R 0000	450 ms
I XXXX	2.2 sec
I 0000	25 words/min
D XXXX	360 ms
N 0000	145 ms
M XXXX	360 ms
P XXXX	250 ms *
E 0000	150 ms
E XXXX	125 ms
U XXXX	130 ms
T XXXX	140 ms
H XXXX	300 ms
C XXXX	310 ms
A XXXX	500 ms **
S XXXX	500 ms **
P 0000	~2.5 sec

Notes: * Except tab and carriage return.

** Somewhat less if either the memory location or accumulator contains zero.

Coding sheets for this program are assembled as Division (2) of Program F2-122

LGP-30 CODING SHEET

Division (2)
Program F2-122

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY:	PROGRAM CHECKED BY:	DATE
	A1-121	R.A. Koenig	POOL Review	5-7-59
PROBLEM:				TRACK
Floating Point Interpreter (With Trace)				00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0000	B	[ ]	/	Instr. To Be Inter. R & U to here	
		01	XH	6330	/	Instr.	
		02	Y	0117	/	Set up add	in bring routine
		03	E	0218	/	☒ XS0000	Save order bits
		04	M	0026	/	1@ 14	Shift to 29
		05	A	0455	/	Lo Transfer Table	(U0438)
		06	C	0009	/		
		07	800T	1063	/	☒→T.C. Down	- Trace
		08	XB	6330	/	Instr.	
		09	[ ]		/	U to transfer table	
		10	XC	6325	/	Dump Acc	Here N=0 on Std.
		11	H	0042	/	☒ F.P. Acc	
		12	H	0041	/	Exp Acc	
		13	B	0628	/	1 @ 29	
		14	A	0000	/	} Modify	Add for next
		15	Y	0000	/	☒ } Instr.	
		16	800T	0718	/	T.C. Down -	Print F.P. Acc
		17	U	0000	/		
,0000 0004	'	18		2	/	1 @ 30	(1003)
		19		800	/	☒ 1 @ 20	}
		20	10	0000	/	1 @ 11	} Shift Right
		21	2000	0000	/	1 @ 2	} Table for Exp.
		22	R	0137	/	} Store	Here: Hold
		23	U	0138	/	☒ } Subroutine	
		24	U	0013	/	→ To next command	
,0000 0007	'	25	8000	0000	/	-1 @ 0	(0353)
		26	2	0000	/	1 @ 14	(0004)
		27	8000	0000	/	☒ -1@ 0	(0062,0162)
		28	J000	0000	/	$-\frac{1}{2}$ @ 0	(0342)
		29	4	0004	/	XI0001	(0614)
		30		4	/	1 @ 29 & 4 @ 31	(1144)
		31	6000	0000	/	☒ 3 @ 2	(0045)

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 00

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0032	R	0061	/	} Find Add	
		33	U	0038	/	} of exp.	
		34	A	0456	/	(z0019)	Lo shift right table
		35	Y	0114	/	☒ M[ ]	
		36	U	0113	/	→ Bring Fr and Exp.	
		37	XZ	0763	/	Mask	(0115)
		38	E	0103	/	3w80	
		39	XH	6325	/	☒ Track and 32 bit of sector	
		40	U	0043	/		
		41	[	]	/	Exponent Acc	
		42	[	]	/	Fraction Acc.	
		43	B	0101	/	☒ 7J	
		44	XE	6330	/	Original Instr.	
		45	D	0031	/	3 @ 2	
		46	XH	6332	/	Integer and Fr. @ 27	
		47	M	0526	/	☒ 1 @ 2	
		48	A	0934	/	(XZ0024)	
		49	U	0053	/		
,0000 0003	/	50	3W	WWW0	/	}	
		51	7WJO	1WW0	/	☒ } Mask Table	
		52	7WWW	Q000	/	} for exponents	
		53	XA	6325	/	Track and 32 sector bit	
		54	Y	0133	/	B[ ] for store	
		55	Y	0113	/	☒ B[ ] for bring	
		56	U	0057	/		
		57	Y	0136	/	C[ ]	
		58	B	0416	/	3 @ 29	
		59	U	0060	/	☒	
		60	XE	6332	/	Save index bits at 29	
		61	U	[ ]	/	exit from exp. add. generator	
		62	M	0027	/	-1 @ 0	(0146)(0112)
		63	H	0042	/	☒	

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0100	U	0013	/	→ To next instr.	
		0101	XZ	0031	/	Mask (0043) & Delay	
		0102	U	0013	/	→ To next Instr.	
		0103	XZ	6332	/	☒	
		0104	R	0119	/	Bring	Here Bring
		0105	U	0032	/	Subr.	
		0106	H	0042	/	F.P. Acc	
		0107	U	0109	/	☒	
		0108	XE	0001	/	Dummy	(0229)
		0109	XB	6331	/	Exp. From Temp.	
		0110	U	0012	/	→ Store Exp & Next Command	
		0111	XC	6361	/	☒ Dump	Here N=0
		0112	U	0658	/	To Bin Exit	in 6-bit Bin.
		0113	B	[ ]	/	Exp. loc.	
		0114	M	[ ]	/	1 @ 2, 1 @ 11 or 1 @ 20	
		0115	E	0037	/	☒ 7WJ Save 9 bits @ 29	
		0116	XH	6331	/	Store Exp Temp.	
		0117	B	[ ]	/	Fract.	
		0118	XH	6333	/	Fr. temp.	
		0119	U	[ ]	/	☒ Exit bring Subr.	
		0120	B	0042	/	F.P. Acc	(0156)
		0121	U	0124	/		
		0122	XZ	0400	/	256 @ 29	(0557)
		0123	XZ	0401	/	☒ 257 @ 29	(0301)
		0124	C	[ ]	/	Store Fr.	
		0125	S	0304	/	512 @ 29	
		0126	A	0041	/	Exp Acc	
		0127	T	0129	/	☒ Exp < 512	o.k.
		0128	U	0315	/	Exp out of range > 256	
		0129	A	0744	/	512 @ 29	
		0130	T	0453	/	→ Exp Neg - Store as Zero	
		0131	N	[ ]	/	☒ 1 @ 29, 1 @ 20 or 1 @ 11	

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JOB NO.

PROGRAM NO. A1-121

PROGRAM PREPARED BY: R.A. Koenig

PROGRAM CHECKED BY: POOL Review

DATE 5/7/59

PROBLEM: Floating Point Interpreter (With Trace)

TRACK 01

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	X					
		01 32	X H	6300	/	Exp shifted for storage	
		33	B	[ ]	/	Exp loc	
		34	E	[ ]	/	Mask out old exp	
		35	X A	6300	/	X New exp	
		36	C	[ ]	/	Store exp	
		37	U	[ ]	/	exit from store subr.	
		38	Y	0124	/	Enter store subr. here	
		39	R	0061	/	X } Add.	
		40	U	0038	/	} Gen. for exp.	
		41	A	0563	/	Z0421 Lo shift left table	
		42	U	0152	/		
		43	R	0222	/	X Here: N neg in std.	
		44	U	0161	/		
		45	B	0042	/	F.P. Here: Change Sign Y	
		46	U	0062	/	Comple, store back & next comm.	
		47	X B	6305	/	X Fs (0327)	
		48	M	[ ]	/	Shift right 1@ 1 - 1 @30	
		49	U	0150	/		
		50	X A	6301	/	F_L	
		51	U	0923	/	X	
		52	Y	0131	/	N[ ] set up left shift to store exp	
		53	U	0154	/		
		54	S	0512	/	(XZ0335) Gen index + 0050	
		55	Y	0134	/	X Set up E [ ]	
		56	U	0120	/	Complete storing opn.	
		57	R	0222	/	Here std. pos. n	
		58	U	0220	/		
		59	U	0013	/	X To next instr.	
		60	X Z	0400	/	256 @29 (0210)	
		61	S	0240	/	1 @30	
		62	M	0027	/	-1 @0 (0143)	
		63	H	0042	/	X Complement Acc.	

X CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Tace) | TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0200	U	0221	/		
		01	R	0137	/	} Store	Here: Clear
		02	U	0138	/	} Subt.	
		03	U	0011	/	☒ → Clear Acc's & next instr.	
		04	R	0119	/	} Bring	Here: Multiply
		05	U	0032	/	} Subr.	
		06	M	0042	/	F.P. Acc	
		07	H	0042	/	☒ New Fr.	
		08	B	0041	/	Exp. Acc.	
		09	XA	6331	/	E_b Temp	} Gen
		10	S	0160	/	256@ 29	} New Exp
		11	U	0212	/	☒ ↓	
		12	H	0041	/	Exp. Acc	
		13	B	0042	/	F.P. ACC	Here: Standardize
		14	T	0928	/	N Neg	
		15	S	0030	/	☒ 1 @29	
		16	T	0010	/	→ N=0	
		17	U	0157	/	→ Here N Pos	
		18	XS	0000	/	Mask	(000)
		19	H	0041	/	☒ Exp. Acc.	
		20	B	0042	/	F.P. Acc	
		21	N	0250	/	1 @30	
		22	T	[ ]	/	Exit from Std.	} Standardize
		23	C	0042	/	☒	} Loop
		24	U	0225	/		
		25	S	0361	/	↓ 1 @29	
		26	A	0041	/	Exp. Acc	
		27	U	0219	/	☒	
		28	Y	0231	/		Here: Exit
		29	S	0108	/	XE0001	
		30	T	0328	/	XE0000	Exit Sequentially
		31	U	[ ]	/	☒ Exit from F.P. w/transfer	

☒ CARRIAGE RETURN

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JOB NO.

PROGRAM NO. A1-121

PROGRAM PREPARED BY: R.A. Koenig

PROGRAM CHECKED BY: POOL Review

DATE 5/7/59

PROBLEM: Floating Point Interpreter (With trace)

TRACK 02

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0232	XZ	0063	/	Mask	(1126,1129)
		33	R	0119	/	} Bring B into	Here Add
		34	U	0032	/	} temp	
		35	T	0305	/	☒ OK to add	
		36	S	0251	/	1@ 30	
		37	T	0013	/	→ No add or subtract	
		38	U	0305	/	→ ok to add	
,0000 0002	!	39	2000	0000	/	☒ 1@ 2	(0610)
		40		2	/	1@ 30	(0161)
		41	A	0463	/	30 @29	
		42	T	0502	/	→ F_B = Σ	
		43	S	0315	/	☒ 30 @29	
		44	M	0402	/	-1@ 0	Compliment diff.
		45	XH	6360	/	Diff in exps.	
		46	B	0042	/	F.P. acc	
		47	XH	6305	/	☒ Fs	
		48	U	1059	/		
,0000 0005	!	49	1400	0000	/	10@ 6	(1148, 1141)
		50		2	/	1 @30	(0221, 0607, 0921)
		51		2	/	☒ 1 @30	(0236,0215,0429,0622)
		52	8	0004	/	XP0001	(0509)
		53	4000	0000	/	½ @0	(0517)
		54	R	0119	/	} Bring subr.	Here: div.
		55	U	0032	/	☒ }	
		56	B	0042	/	F.P. acc.	
		57	M	0415	/	1@ 1	
		58	U	0261	/		
		59	Z	0525	/	☒ Lo shift table	(0323)
		60	XZ	0100	/	4 @ 25	(1152)
		61	XD	6333	/	F_B	
		62	U	0263	/		
		63	C	0042	/	☒ Store Fr in F.P. Acc	

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JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY: R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0300	B	0041	/	Exp. Acc	
		01	A	0123	/	257 @ 29	
		02	XS	6331	/	E_b Temp	
		03	U	0212	/	☒ To Std	
		04	XZ	0800	/	512 @ 29	(0125)
		05	B	0041	/	Exp Acc	Start adding here
		06	U	0309	/		
,0000 0002	'	07	4000	0000	/	☒	
		08		4	/		
		09	XS	6331	/	E_b	
		10	XH	6360	/	Diff in Exp. at 29	
		11	T	0241	/	☒ $E_b > E_a$	
		12	S	0462	/	30 @ 29	Here $E_b \leq E_a$
		13	T	0318	/	→ Continue Add	
		14	U	0013	/	→ $E_a = \Sigma$	No Add needed
		15	XZ	0030	/	☒	
		16	U	0010	/		
		17			/		
		18	XB	6333	/	F_b	} Store F_b As
		19	XH	6305	/	☒ Fs	} Fs
		20	B	0042	/	F.P. Acc	
		21	M	0307	/	1 @ 1	
		22	XH	6301	/	F_L (Shifted rt. 1)	
		23	B	0259	/	☒ Lo shift table (Z0525)	
		24	XA	6360	/	Diff @ 29	
		25	U	0326	/		
		26	Y	0148	/	M[ ]	
		27	U	0147	/	☒ Complete Add.	
		28	B	0000	/	Here	(XE0000)
		29	A	0308	/	1 @ 29	
		30	Y	0331	/	set up exit	
		31	U	[ ]	/	☒ Exit f.p.	

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☒ CARRIAGE RETURN

ROYAL McBEE J13541X

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 03

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		03 32			/		
		33	XH	6305	/	X_i	
		34	XH	6306	/	X_i	
		35	U	0338	/	☒	
		36	XZ	0400	/	Z or N order	
		37	U	0013	/	To next instruction	
		38	XC	6310	/	X_i	
		39	XS	6304	/	☒ a	
		40	XD	6305	/	X_i	
		41	XA	6306	/	X_i	
		42	M	0028	/	$-\frac{1}{2}$ @ 0	
		43	T	0359	/	☒	
		44	U	0424	/	Sq. Rt. Complete	
		45	XZ	0001	/	1@ 29 Stop: $\sqrt{\text{Neg. No.}}$	
		46	U	0010	/	Clear acc. and continue	
		47	R	0119	/	☒ Bring subr.	Here: Subtract
		48	U	0032	/		
		49	U	0353	/		
		50			/		
		51	XB	6330	/	☒ (0400)	
		52	U	0015	/		
		53	M	0025	/	-1@ 0	Complement F_B
		54	XH	6333	/		in S
		55	U	0235	/	☒ → To add section	
		56			/		
		57			/		
		58			/		
		59	XA	6310	/	☒ X_i	
		60	U	0333	/		
,0000002	'	61		4	/	1 @ 29	(0225, 0925)
		62	7WWW	WWWQ	/		(0419)
		63	B	0042	/	☒	Here: Test

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0400	T	0351	/	→ Acc Neg:	Transfer
		01	U	0013	/	→ Acc Pos:	Next Instr.
,0000 0002	/	02	8000	0000	/	-1 @ 0	(0244)
		03	4000	0000	/	☒ 1 @ 1	(0417)
		04	B	0433	/	1 @ 29	
		05	E	0041	/	Exp Acc.	Save odd bit
		06	S	0628	/	1 @29	
		07	T	0560	/	☒ → Exp. Even	
		08	U	0434	/	→ Exp. Odd	
		09	A	0345	/	1 @ 29	
		10	A	0041	/	Exp. Acc	
		11	U	0516	/	☒	
		12	H	0041	/	Exp Acc	
		13	B	0042	/	F.P. Acc	
		14	U	[ ]	/	Exit New	Exp √
,0000 0003	/	15	4000	0000	/	☒ 1 @ 1	(0257)
		16		J	/	3 @ 29	(0058)
		17	M	0403	/	1@ 1	
		18	XC	6304	/	a	
		19	B	0362	/	☒ 7WWWWWWQ	1st guess
		20	U	0333	/		
,0000 0003	/	21	10	0000	/	1 @ 11	Shift left
		22		800	/	1 @ 20	table (0125)
		23		4	/	☒ 1 @ 29	
		24	XB	6310	/	xi Here	√ done
		25	H	0042	/	F.P. Acc	
		26	U	0013	/	→ Next Command	
		27	B	0042	/	☒ Here: Square root	
		28	T	0345	/	→ a < 0	stop and substitute 0
		29	S	0251	/	1 @ 30	
		30	T	0013	/	→ a = 0	to next command
		31	U	0404	/	☒ a > 0	continue

☒ CARRIAGE RETURN

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JOB NO.

PROGRAM NO. A1-121

PROGRAM PREPARED BY R.A. Koenig

PROGRAM CHECKED BY: POOL Review

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PROBLEM: Floating Point Interpreter (With Trace)

TRACK 04

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0432			/		
		33	XZ	0001	/		
		34	XC	6363	/	} Here Sq. Rt. Exp. odd	
		35	R	0414	/	☒	
		36	U	0409	/		
		37	U	0417	/		
		38	U	0844	/	Z	Transfer table
		39	U	0104	/	☒ B	
		40	U	0145	/	Y	
		41	U	0427	/	R	
		42	U	0513	/	I	
		43	U	0254	/	☒ D	
		44	U	0844	/	N	
		45	U	0204	/	M	
		46	U	0508	/	P	
		47	U	0228	/	☒ E	
		48	U	0015	/	U	
		49	U	0361	/	T	
		50	U	0022	/	H	
		51	U	0201	/	☒ C	
		52	U	0233	/	A	
		53	U	0347	/	S	
		54	XZ	0004	/	4@ 29	(0408)
		55	U	0438	/	☒ Lo transfer table	(0005)
		56	Z	0019	/	Lo shift Rt. table	(0034)& Delay
		57	U	0000	/		
		58	XC	6309	/	Dump here Exp neg. in store	
		59	C	0041	/	☒ Exp. acc	
		60	C	0042	/	F.P. acc	
		61	U	0124	/	Return of store open	
		62	XZ	0030	/	30 29	(0312)
		63	XZ	0030	/	☒ 30 29	(0241)

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0500	[	]	/	Here execute char. print.	
		01	U	0101	/		
		02	XB	6331	/	E_B	Here $F_B=\Sigma$
		03	H	0041	/	☒ Exp Acc	
		04	XB	6333	/	F_B	
		05	U	0506	/		
		06	H	0042	/	F.P. acc	
		07	U	0013	/	☒ To next command	
		08	H	0500	/		Here on Print
		09	S	0252	/	XP0001	
		10	T	1053	/	XP0000	
		11	U	0500	/	☒ XPXXXX	Execute Command
		12	XZ	0335	/	0154	
		13	R	0963	/	} Input	Here Input
		14	U	0614	/	} Routine	
		15	U	0013	/	☒ Next Command	
		16	S	0545	/	256 @ 29	
		17	M	0253	/	$\frac{1}{2}$ @ 0	
		18	A	0961	/	256 @ 29	
		19	U	0412	/	☒	
		20	B	0042	/	F.P. Acc	
		21	R	1447	/	} E.R.F.P. Print	
		22	U	1300	/	}	
		23	80XZ	0000	/	☒ Delay & -1	@0 (0244,1151)
		24	U	[ ]	/	Exit on Print	
,0000 0030	'	25	4000	0000	/	1 @ 1	
		26	2000	0000	/	1 @ 2	(0047)
		27	1000	0000	/	☒ 1 @ 3	Shift table
		28	800	0000	/	1 @ 4	
		29	400	0000	/	1 @ 5	
		30	200	0000	/	1 @ 6	
		31	100	0000	/	☒ 1 @ 7	

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 05

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		052	80	0000	/	1 @ 8	
		53	40	0000	/	1 @ 9	
		54	20	0000	/	1 @ 10	
		55	10	0000	/	☒ 1 @ 11	
		56		8000	/	1 @ 12	
		57		4000	/	1 @ 13	
		58		2000	/	1 @ 14	
		59		1000	/	☒ 1 @ 15	
		60		8000	/	1 @ 16	
		61		4000	/	1 @ 17	
		62		2000	/	1 @ 18	
		63		1000	/	☒ 1 @ 19	
		64		800	/	1 @ 20	
		65		400	/	1 @ 21	& 256 @ 29 (0516)
		66		200	/	1 @ 22	
		67		100	/	☒ 1 @ 23	
		68		80	/	1 @ 24	
		69		40	/	1 @ 25	
		70		20	/	1 @ 26	
		71		10	/	☒ 1 @ 27	
		72		8	/	1 @ 28	
		73		4	/	1 @ 29	(1110)
		74		2	/	1 @ 30	(0932)
		75	B	0041	/	☒ Exp. Acc	Here: P0000
		76	U	0557	/		
		77	S	0122	/	256 @ 29	
		78	XC	6316	/		
		79	U	0520	/	☒ To print sub.	
		80	R	0414	/	} Here exp even √	
		81	U	0409	/		
		82	U	0418	/		
		83	Z	0421	/	☒ Lo shift left table	(0141)

☒ CARRIAGE RETURN

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PROBLEM: Floating Point Interpreter (With Trace) | TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
,0004	1	0600		700	/	Mask	(1142)
		01		9J4	/	10^4 @ 33	(0750)
		02	12J	Q8KF	/	"Exit"	(0937)
		03		80214	/	☒	(1145,1153)
		04	XC	6347	/	R Ctr	
		05	XP	0020	/	} Read 2nd word	
		06	XI	0021	/	}	
		07	N	0250	/	☒ 1 @ 30	
		08	R	0658	/	} 6-bit bin.	
		09	U	0619	/	}	
		10	M	0239	/	1@ 2	Shift to 30
		11	XH	6340	/	☒ Store lower half	
		12	U	0722	/	→ Assemble word	
		13	XZ	0431	/	287 @ 29	(0741)
		14	S	0029	/	XI0001	
		15	T	0945	/	☒ → Seq. fill	
		16	R	0963	/	} Single word fill	
		17	U	0949	/	}	
		18	U	0963	/	→ Exit	
		19	XH	6305	/	☒ N in 6 bit	
		20	S	0763	/	1 @ 30	
		21	T	0111	/	→ N = 0	
		22	A	0251	/	1 @ 30	
		23	E	0659	/	☒ 2082082	Save 6th bits
		24	S	0860	/	1 @ 30	
		25	T	0632	/	→ no "." in word	
		26	U	0932	/	→ to dec. pt. exit	
,0005	1	27	420	J400	/	☒ 1 @ 5 + 2 @ 11 + 3 @ 17 + 4 @ 23	(0755)
		28		4	/	1 @ 29 (0013, 0406, 0949)	
		29	3W	8000	/	Mask	(0643)
		30	7J00	0000	/	Mask	(0651)
		31		14	/	☒ 5 @ 29	(0719)

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JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY R.A. Koenig | PROGRAM CHECKED BY POOL Review | DATE 5/7/59

PROBLEM: Floating Point Interpreter (With Trace)

TRACK 06

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	'						
	'	☒					
		0632	B	0754	'	79q79q8	
		33	XE	6305	'	N in 6-bit	Trim to BCD
		34	XH	6306	'	N_1	
		35	U	0639	'	☒	
,0000001	'	36	12J	Q8K8	'	Exit - 1@ 30	
		37	XB	6330	'	Instr. to Trace	
		38	U	0646	'		
		39	E	0761	'	☒ 1q01q00	
		40	M	0762	'	-54 @ 6	
		41	XA	6306	'	N_1	
		42	XH	6307	'	N_2	
		43	E	0629	'	☒ 3w8000	
		44	M	0916	'	-3996 @ 12	
		45	U	0649	'		
		46	M	0530	'	4 @ 8	Form Print for Instr.
		47	A	0656	'	☒ XP0100	
		48	U	0830	'		
		49	XA	6307	'	N_2	
		50	XH	6308	'	N_3	
		51	E	0630	'	☒ 7J000000	
		52	M	0917	'	-16,677,216	@ 24
		53	U	0657	'		
		54	XB	6330	'		Command to be Traced
		55	U	1046	'	☒ To Bring Fr. & Exp.	
,0000011	'	56	8	0100	'	XP0100	(0647)
		57	A	3w20	'	XA6308 N_3	
		58	U	[ ]	'	Exit 6-bit Bin	
		59	2082	2082	'	☒ (Mask	(0623)
		60	2000	0000	'	1@ 2	(0610)
		61	WJ	000	'	Mask	(0918)
		62	82000000		'	-63/64 @ 0	(0919)
		63	200	0000	'	☒ 1 @ 6	(0827)

☒ CARRIAGE RETURN

PREPARED FOR: LGP-30 RPC-4000 USERS ORGANIZATION - POOL

PAGE 15 / 24

JOB NO.

PROGRAM NO. A1-121

PROGRAM PREPARED BY: R.A. Koenig

PROGRAM CHECKED BY: POOL Review

DATE 5/7/59

PROBLEM: Floating Point Interpreter (With Trace)

TRACK 07

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0700		61F8	/	10^5 @33	(0714)
		01	94968000		/	8 x 10^7 @ 30	(0815)
		02			/		
		03	E	0732	/	☒ WOOWOO	
		04	M	0733	/	-54 @ 6	
		05	XA	6327	/	N_1	
		06	U	0913	/		
		07	E	0729	/	☒ 7WWWWWQ	Drop sign bit
		08	R	0658	/	Set up bin exit 1st word	
		09	U	0711	/		
		10	U	0746	/		
		11	R	0933	/	☒ Set up "." in 1st word	
		12	U	0619	/	→ 6 bit bin	
		13	XH	6335	/	De. Pt. Loc, Here "." in 1st word	
		14	B	0700	/	10^5 @ 33	
		15	XC	6337	/	☒ M_1	
		16	B	0631	/	5 @ 29	
		17	U	0752	/		
		18	R	0524	/	} Print Acc. on T.C.	
		19	U	0555	/	☒ } depressed	
		20	XP	1606	/	} c.r.	
		21	U	1034	/		
		22	XB	6337	/	M_1 = 10^4 or 10^5 @ 33	
		23	U	0724	/	☒	
		24	XN	6332	/	1st word @28	
		25	XA	6340	/	2nd half @30	
		26	S	0962	/	1 @30	
		27	T	0941	/	☒ → N = 0	
		28	U	0813	/	→ To normalize	
0000006	/	29	7WWW	WWWQ	/	Mask	(0707)
		30		28	/	10 @29	(0908)
		31		28	/	☒ 10 @29	(0902)

☒ CARRIAGE RETURN

PREPARED FOR: LGP-30 RPC-4000 USERS ORGANIZATION - POOL | PAGE 16 / 24

JOB NO. | PROGRAM NO. Al-121 | PROGRAM PREPARED BY: R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5/7/59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 07

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	X					
		0732	W O	0W00	/	Mask	(0703)
		33	9400	0000	/	-54 @ 6	(0704)
		34		4	/		
		35	X B	6350	/	X N @ 30	
		36	M	0915	/	1@1	
		37	D	[ ]	/	} Scale @P	
		38	D	[ ]	/	@R	
		39	U	0740	/	X	
		40	X C	6322	/	N*	
		41	B	0613	/	287 @ 29	
		42	S	[ ]	/	q for R shifts	
		43	U	0846	/	X	
		44	X Z	0800	/	512 @ 29	(0129)
		45			/		
		46	X C	6332	/	1st word @28	
		47	R	0933	/	X set "." exit for 2nd word	
		48	U	0604	/	Read 2nd word	
		49	X H	6335	/	D.P.loc	
		50	B	0601	/	10^4 @ 33	
		51	X C	6337	/	X M_1	
		52	X C	6310	/	Temp P Ctr.	
		53	U	0755	/		
0000 0001	!	54	7907	9078	/		
		55	B	0627	/	X 1 @5 + 2@11 + 3 @17 + 4 @23	
		56	X M	6335	/	Dec. Pt. Loc	
		57	E	0843	/	XZ0007	Save 3 bits @ 29
		58	X H	6344	/	Dec. Pt. Index	
		59	X A	6310	/	X Temp P ctr.	
		60	U	0800	/		
0000 0003	!	61	1Q01	Q000	/	Mask	(0639)
		62	9400	0000	/	-54 @ 6	(0640)
		63		2	/	X 1 @ 30	(0620)(0813)

Royal McBee Corporation
DATA PROCESSING DIV.
PORT CHESTER, NEW YORK

FORM LP-12

X CARRIAGE RETURN

ROYAL M-BEE J13541X

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL

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JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY: R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 08

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0800	X	C6343	/		Store P Ctr.
		01	X	B6344	/		Dec. Pt. Index
		02	A	0824	/	Z1037	
		03	Y	0825	/	☒	Set up Mask for Removing Dec. Pt.
		04	A	0454	/	4 @29	
		05	Y	0834	/		
		06	U	0825	/		
,00000003	/	07			/	☒	
		08		F	/	10 @ 31	(0822)
		09		7J	/	Mask	(0951)
		10	R	0853	/	Set up	Here N Neg
		11	U	9707	/	☒ Neg. Exit	
		12	U	1049	/	→ Complement Fraction	
		13	A	9763	/	1 @ 30	
		14	X H	6350	/	N @ 30	
		15	S	9701	/	☒ 8×10^7 @ 30	
		16	T	9818	/	→ N Not Normalized	
		17	U	9863	/	→ N Normalized	
		18	X B	6347	/	R Ctr.	Normalize
		19	A	9734	/	☒ 1 @ 29	Loop
		20	X H	6347	/	R Ctr.	
		21	X B	6350	/	N	
		22	N	9808	/	10 @31	
		23	U	9814	/	☒	
		24	Z	1037	/	Lo Mask #2	Table
		25	B	[ ]	/	Mask #2	
		26	X E	6305	/	Original Word	
		27	M	9663	/	☒ 1@6	
		28	X H	6307	/	L.H. Portion	
		29	U	9833	/		
		30	C	9831	/		
		31	[ ]		/	☒ Print Operation Char. in Tracing	

☒ CARRIAGE RETURN

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL | PAGE 18 / 24

JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 08

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	X					
		0832	U	1117	/		
		33	XB	6305	/		Original Word
		34	E	[ ]	/		Save R.H.Portion
		35	XA	6307	/	X	L.H. Portion
		36	U	0634	/	→	Return to Binarize
		37	XC	6302	/		Read Address
		38	XP	0003	/		
		39	XI	0004	/	X	
		40	E	0862	/	w3Jw3J	Trim to BCD
		41	XA	6327	/	N_1	
		42	U	0703	/		
		43	XZ	0007	/	X Mask	(0757)
		44	B	0000	/	Here on Z or N : Stop Order	
		45	U	0336	/		
		46	S	[ ]	/	q from P	shifts
		47	U	0849	/	X	
		48	Z	1024	/	Lo q table	(0905)
		49	XH	6321	/	q @ 29	Standardization Loop
		50	XB	6322	/	N *	
		51	N	0859	/	X 1 @ 30	
		52	U	0853	/		
		53	T	[ ]	/	Exit from Std.	
		54	XC	6322	/	N *	
		55	S	0734	/	X 1 @ 29	
		56	XA	6321	/	q @ 29	
		57	U	0849	/		
,0000005	'	58	5G3W	8GQ8	/	Group - Exit	(0936)
		59		2	/	X 1 @ 30	(0851,1009)
		60		2	/	1 @ 30	(0624)
		61	5G3W	8GQ6	/	Group - Exit	-1 @ 30
		62	W3	JW3J	/	Mask	(0840)
		63	B	0935	/	X (Z1014)	Lo 10^k Table

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL | PAGE 19 / 24

JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY: R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 09

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		0900	X	A 6343	/		P Ctr.
		01	Y	0737	/		Set up P divide
		02	A	0731	/	XZ0010	
		03	Y	0846	/	☒	Set up P adj. of q
		04	X	B 6347	/		R Ctr.
		05	A	0848	/	Lo of q Table (Z1024)	
		06	Y	0742	/		Set up R adj. of q
		07	U	0908	/	☒	
		08	S	0730	/	10 @ 29	
		09	Y	0738	/		Set up R divide
		10	U	0735	/		Here Exit from Input
		11	X	P 1661	/	☒ c.r.	
		12	U	0962	/	→ To delay and Exit	
		13	X	H 6363	/	N_2	
		14	U	0918	/		
,0000 0003	/	15	4000 0000		/	☒ 1 @ 1	(0736)
		16	8320 0000		/	-3996 @ 12	(0644)
		17	8013 8800		/	-16,677,216 @24	(0652)
		18	E	0661	/	WJ000	
		19	M	0662	/	☒ -63/64 @0	
		20	X	A 6363	/	N_2	
		21	U	0950	/		
		22			/		
		23	H	0042	/	☒ F.P. Acc.	Here complete Add
		24	B	0041	/		
		25	A	0361	/		Δ Exp. Acc by 1
		26	H	0041	/		
		27	U	0213	/	☒ →	To Standarize
		28	A	0250	/	1 @ 30	Here N
		29	T	0143	/	O.K. to Std.	Neg in
		30	U	0011	/	Set Acc = 0 & Next Inst.	Std.
		31			/	☒	

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☒ CARRIAGE RETURN

ROYAL McBEE J13541X

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL

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JOB NO.	PROGRAM NO.	PROGRAM PREPARED BY	PROGRAM CHECKED BY	DATE
	A1-121	R.A. Koenig	POOL Review	5-7-59

PROBLEM: Floating Point Interpreter (With Trace)

TRACK 09

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/				/		
	/	☒					
		09 32	A	0554	/	1 @ 30	
		33	U	[ ]	/		Bin. Exit w/ Dec. Pt.
		34	XZ	0024	/	24 @29	(0048)
		35	Z	1014	/	☒ Lo 10^k Table	(0863)
		36	A	0858	/		Group - Exit
		37	A	0602	/		Exit
		38	R	0853	/		Set up Pos Exit
		39	U	0708	/	☒	
		40	U	0953	/	→	Store Word
		41	XC	6320	/		Here N = 0 after all Binirization & Assembly
		42	XC	6321	/		
		43	XC	6322	/	☒	
		44	U	0954	/		
		45	R	0960	/		Here I0000 : Fill Sequentially
		46	U	0837	/	Read Add	
		47	U	0948	/	☒	
		48	B	1036	/		Δ Address for Seq. Fill
		49	A	0628	/	1 @ 29	
		50	H	1036	/		
		51	XC	6330	/	☒ Dump	
		52	U	1000	/		Read 1st Word
		53	XB	6321	/	Exp @ 29	
		54	H	0041	/	Exp Acc.	
		55	XB	6322	/	☒ Fr. Std	
		56	H	0042	/	F.P.ACC.	
		57	B	1036	/		Address
		58	R	0137	/		Store N
		59	U	0138	/	☒	
,0000004	1	60	U	[ ]	/	Exit on Single or Seq. Fill	
		61		400	/		
		62		2	/	1 @ 30	(0726)
		63	U	[ ]	/	☒ Exit from	Input Section

☒ CARRIAGE RETURN

Royal McBee Corporation
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PORT CHESTER, NEW YORK

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PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL

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JOB NO.

PROGRAM NO. A1-121

PROGRAM PREPARED BY: R.A. Koenig

PROGRAM CHECKED BY: POOL Review

DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace)

TRACK 10

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		1000	XC	6343	/		
		001	XP	0016	/		
		002	XI	0017	/		
		003	N	0018	/	☒	
		004	T	0810	/		
		005	S	1034	/		
		006	T	0938	/		
		007	S	0636	/	☒	
		008	T	0937	/		
		009	S	0859	/		
		010	T	0911	/		
		011	S	0861	/	☒	
		012	T	0936	/		
		013	U	0837	/		
0,000,021	/	014	7W	WWWWQ	/	10^0 @ 0	
		015	50	0000 0000	/	☒ 10^1 @ 4	
		016	64	0000 0000	/	10^2 @ 7	
		017	7K	0000 0000	/	10^3 @ 10	
		018	4Q	2000 0000	/	10^4 @ 14	10^k Table
		019	61	F800 0000	/	☒ 10^5 @ 17	
		020	7F	1200 0000	/	10^6 @ 20	
		021	4J	4G40 000	/	10^7 @ 24	
		022	5W	5Q10 000	/	10^8 @ 27	
		023	77	3594 000	/	☒ 10^9 @ 30	
		024		0	/	0 @ 29	
		025		10	/	4 @ 29	
		026		1J	/	7 @ 29	
		027		28	/	☒ 10 @ 29	q Table
		028		38	/	14 @ 29	
		029		44	/	17 @ 29	
		030		50	/	20 @ 29	
		031		60	/	☒ 24 @ 29	

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PORT CHESTER, NEW YORK

FORM LP-10

☒ CARRIAGE RETURN

ROYAL McBEE, J13841X

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL | PAGE 22 /24

JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY: R A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 10

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		1032	6J		/	27 @ 29	} Balance of q Table
		33	78		/	30 @ 29	
		34	2		/	Delay & 1@30	(1005)
		35	U	0000	/	☒ →	Interpret next Inst.
,0000010	/	36	[	]	/	Address	(0948, 0950, 0921)
		37	79Q79Q000		/		}
		38	79Q78000		/		} Mask # 1
		39	79Q00000		/	☒	}
		40	78000000		/		} Decimal Point
		41	0		/		} Masks
		42	78		/		}
		43	1Q78		/	☒	} Mask # 2
		44	79Q78		/		}
		45	1Q79Q78		/		}
		46	R	0119	/		} Bring Sub. (Trace)
		47	U	0032	/	☒	}
		48	U	1056	/		
		49	XC	6307	/		} Here N Neg.
		50	XS	6322	/		} Complement N*
		51	XH	6322	/	☒	}
		52	U	0953	/		
		53	R	0524	/		} Here P0000 Print Acc.
		54	U	0555	/		}
		55	U	0013	/	☒ →	To next command
		56	XB	6331	/	Exp	
		57	U	1158	/		
		58			/		
		59	XB	6331	/	☒ E_B	Complete Bring
		60	H	0041	/	Exp. Acc.	
		61	XB	6333	/	F_B	
		62	U	0321	/		
		63	B	0000	/	☒	Enter Tracing Mode Here

☒ CARRIAGE RETURN

PREPARED FOR: LGP-30, RPC-4000 USERS ORGANIZATION - POOL | PAGE 23 / 24

JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY: R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 11

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		1100	R	1123	/	}	Print Loc of Instr.
		01	U	1121	/	}	
		02	U	0637	/		
		03	XB	6330	/	☒ Instr. to	be Interpreted
		04	M	0026	/	1 @ 14	
		05	E	1134	/	XZ0015	Save order bits @ 29
		06	S	1136	/	5 @ 29	
		07	T	0008	/	☒ →	Z,B,Y,R,I Continue
		08	S	1130	/	1 @ 29	
		09	T	0654	/	→ D	Print Contents of Memory & Continue
		10	S	0553	/	1 @ 29	
		11	T	0008	/	☒ → N →	Continue
		12	S	0734	/	1 @ 29	
		13	T	0654	/	→ M →	Print Contents of Mem.
		14	S	1138	/	6 @ 29	
		15	T	0008	/	☒ →	P,E,U,T,H,C, Continue
		16	U	0654	/		Here A or S Command
		17	XB	6330	/	Instruction	
		18	R	1123	/	} Print	Add. portion of Instr.
		19	U	1121	/	☒	
		20	U	1103	/	→	Determine type of Order
		21	R	1139	/	}	Print Address
		22	U	1124	/	}	
		23	U	[ ]	/	☒	Exit Address Print
		24	XH	6353	/		Address
		25	M	0530	/	1 @ 6	
		26	E	0232	/	(XZ0063)	Save sector bits @ 29
		27	R	1157	/	☒ }	Print Track Portion
		28	U	1140	/	}	
		29	B	0232	/	(XZ0063)	
		30	XZ	0001	/	Delay & 1 @ 29	(1108)
		31	XE	6353	/	☒ Address	

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☒ CARRIAGE RETURN

ROYAL McBEE, J13541X

PREPARED FOR: LGP-30,RPC-4000 USERS ORGANIZATION - POOL

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JOB NO. | PROGRAM NO. A1-121 | PROGRAM PREPARED BY R.A. Koenig | PROGRAM CHECKED BY: POOL Review | DATE 5-7-59

PROBLEM: Floating Point Interpreter (With Trace) | TRACK 11

PROGRAM INPUT CODES	STOP	LOCATION	INSTRUCTION OPERATION	INSTRUCTION ADDRESS	STOP	CONTENTS OF ADDRESS	NOTES
	/						
	/	☒					
		1132	R	1157	/		Print Sector Characters
		33	U	1140	/		
		34	XZ	0015	/	Delay & 15 @ 29	(1105)
		35	XP	0300	/	☒ Space	
		36	XZ	0005	/	Delay & 5 @ 29	(1106)
		37	XP	0302	/	Space	
		38	XZ	0006	/	Delay & 6 @ 29	(1114)
		39	U	1123	/	☒	
		40	XH	6312	/	T or S @ 29	
		41	D	0249	/	10 @ 29	
		42	E	0600	/	XZ0700	Save 3 sector bits
		43	XH	6358	/	☒ S/10 @ 23	
		44	N	0030	/	4 @ 31	
		45	A	0603	/	XP0205	
		46	C	1147	/		
		47	[	]	/	☒	Print 1st Character
		48	B	0249	/	10 @ 6	
		49	XM	6358	/	S/10 @ 23	
		50	XA	6312	/	T or S @ 29	
		51	M	0523	/	☒ -1 @ 0	
		52	N	0260	/	4 @ 25	
		53	A	0603	/	XP0205	
		54	C	1156	/		
		55	U	1156	/	☒	
		56	[	]	/		Print 2nd Character
		57	U	[ ]	/		Exit 2 digit Print
		58	S	0545	/	256 @ 29	
		59	XC	6316	/	☒	
		60	XB	6333	/	F_B	Print Contents of Memory Location
		61	R	0524	/		
		62	U	0521	/		
		63	U	0008	/	☒	Execute Operation

☒ CARRIAGE RETURN