SSEM-MESS: A Simulator

Lee Wittenberg
leew@alumni.stanford.edu

22 January 2022

1 Make-up of Tape

M3
*
θΔφφφφφφφSSEMπA*MESSφSIMULATOR
θΔφφφφφLONGφTANKSφπ2φ*ANDφπ3*φSHOW
θΔφφφφφφφφφφφφK*REVERSEDπL*
θΔφCONTENTSφOFφπK35A*BITπL*φSSEMφSTORE
θΔLINEφπ62CφK35A*BITπL*φACCUMULATOR
θΔLINEφπ60CφK35A*BITπL*φCONTROLφINSTRUCTION
θΔLINEφπ58CφK35A*BITπL*φPRESENTφINSTRUCTION
θΔ
θΔPRESSφRESETφTOφRUNφPROGRAM

] user instructions to be printed

space

P K T 160 K — First order of M1 goes into 160.

M1

P 128 F — Reference order of master program goes into 128.

T 180 K — First order of H sequence goes into 180.

] parameters used by M1

space

P Z G K
E 160 K T F — Calls in M1 which places P 180 F in 45.

H sequence

space

P Z G K
E 160 K T F — Calls in M1 which places P n F (where n is the first even location after the H sequence) in 46.

N sequence

space

P Z G K
T 170 K T ϕ — Sets M1 ready to deal with master routine.
E 160 K I F — Calls in M1, which places reference order in 128.

Master routine

space
P Z G K
E 160 K P F
Auxiliary

Each auxiliary, $n = 1 \cdots 9$, is introduced by blank tape and the control combination P Z G K E 160 P F, which calls in M1 to place a reference order in $128 + n$.

E 25 K
E ϕ P F

Sends control to the first order of the master routine.

2 Number Sequences

2.1 H Sequence

0	(V 2047 D)	SSEM arithmetic mask (32 bits—all ones
1	(E 2047 D)	except sandwich bit); currently unused
2	K F	SSEM func. mask (11100000000000000)
3	P 15 D	SSEM addr. mask (00000000000011111)
4	U 3 F	adjusts A m F order to E $m+3$ F
5	Δ 2047 F	adjusts E $m+3$ F order to A $m+2$ F
6	P D	long integer value 1
7	P F	
8	P 64 F	base location of SSEM store
9	A F	skeleton "add word" order
10	S D	skeleton "subtract long word" order
11	T D	skeleton "store long word" order
12	A D	skeleton "add long word" order

2.2 N Sequence

0	G 3 ϕ	function 0: s, C
1	G 4 ϕ	function 1: $c+s, C$
2	G 5 ϕ	function 2: $-s, A$
3	G 6 ϕ	function 3: a, S
4	G 7 ϕ	function 4:
5	G 7 ϕ	function 5: $a-s, A$
6	G 8 ϕ	function 6: Test
7	G 9 ϕ	function 7: Stop
8	G N	skeleton jump table access order

3 Master Routine

0	A 43 F	set sandwich bit in SSEM arithmetic mask (for possible future use)	
1	R D		
2	A πH		
3	T πH		
4	A 4 θ	read SSEM program	
5	G 2 ϕ		
6	P 64 F	parameter for auxiliary no. 2	
7	Z F	wait for reset to execute SSEM pgm	
26 → 8	A 60 D	increment CI	fetch/ execute cycle
9	A 6πH		
10	T 60 D		
11	H 3 H	get location of SSEM instruction at CI	
12	C 60 F		
13	L 1 F		
14	A 8 H		
15	A 9 H	get SSEM instruction and store in PI	
16	T 17 θ		
17	(A F)		
18	T 58 F		
19	H 2 H	get SSEM function bits	
20	C 58 F		
21	R 1024 F	plant subroutine jump	
22	A 8 N		
23	T 25 θ		
24	A 24 θ	call appropriate subroutine via jump table N	
25	(G N)		

(Add a Z F order here for single-step operation.)

26	E 8 θ	fetch next SSEM instruction	
27	Z F	never reached	

4 Auxiliary Subroutines

4.1 Input Routines

4.1.1 Auxiliary #1

Reads a single 12-digit octal number from the tape, and stores its value in the long word specified by its single parameter.

0	A	4 H	⎤	plant link
1	U	20 θ	⎦	
2	A	5 H	⎤	form "store result" order
3	T	4 θ	⎥	
4	(A	θ)	⎥	
5	A	21 θ	⎦	
6	T	19 θ		plant "store result" order
7	T	26$\pi\theta$		clear result
8	S	22 θ		load negative digit count
17 $\rightarrow$ 9	T	23 θ		save negative digit count
10	A	26$\pi\theta$		load result
11	L	2 F	⎤	add 8 $\times$ result + new digit to result
12	I	24 θ	⎥	
13	A	24$\pi\theta$	⎦	
14	T	26$\pi\theta$		save result
15	A	23 θ		load negative digit count
16	A	2 F		increment count
17	G	9 θ		get next digit (if count < 0)
18	A	26$\pi\theta$		get result
19	(T	D)		store result
20	(Z	F)		link
21	T	D		skeleton "store result" order
22	P	12 F		no. of digits to read
23	P	F		current count (neg. actual count)
24	P	F	⎤	storage for input digits
25	P	F	⎦	
26	P	F	⎤	storage for result
27	P	F	⎦	

4.1.2 Auxiliary #2

Uses first auxiliary subroutine to initialize the contents of the SSEM store.

0	A 4 H	plant link
1	U 17 θ	
2	A 5 H	get parameter (starting store location) and plant it as auxiliary call parameter
3	T 4 θ	
4	(A θ)	
5	T 10 θ	
6	S 18 θ	load negative iteration count
16 → 7	T 19 θ	save negative iteration count
8	A 8 θ	read single octal number
9	G 1 ϕ	
10	(P F)	parameter for auxiliary no. 1
11	A 10 θ	increment store location
12	A 20 θ	
13	T 10 θ	
14	A 19 θ	load negative iteration count
15	A 2 F	increment count
16	G 7 θ	get next number (if count < 0)
17	(Z F)	link
18	P 32 F	32 iterations required
19	(P F)	current count (neg. actual count)
20	P 2 F	2 EDSAC words per SSEM word

4.2 SSEM Function Routines

4.2.1 Auxiliary #3

Implements SSEM function code 0: s, C.

0	A 3 F	plant link	
1	T 10 θ		
2	H 3 H	compute store address from PI	form and plant appropriate operation order
3	C 58 F		
4	L 1 F		
5	A 8 H		
6	A 12 H	form and plant "load" order	
7	T 8 θ		
8	(A D)	s to accumulator	
9	T 60 D	s to CI	
10	(Z F)	link	

4.2.2 Auxiliary #4

Implements SSEM function code 1: $c + s, C$.

0	A	3 F	plant link	
1	T	11 θ		
2	H	3 H	compute store address from PI	form and plant appropriate operation order
3	C	58 F		
4	L	1 F		
5	A	8 H		
6	A	12 H	form and plant "load" order	
7	T	8 θ		
8	(A	D)	s to accumulator	
9	A	60 D	$c + s$ to accumulator	
10	T	60 D	$c + s$ to CI	
11	(Z	F)	link	

4.2.3 Auxiliary #5

Implements SSEM function code 2: $-s, A$.

0	A	3 F	plant link	
1	T	10 θ		
2	H	3 H	compute store address from PI	form and plant appropriate operation order
3	C	58 F		
4	L	1 F		
5	A	8 H		
6	A	10 H	form and plant subtraction order	
7	T	8 θ		
8	(S	D)	$-s$ to accumulator	
9	T	62 D	$-s$ to SSEM accumulator	
10	(Z	F)	link	

4.2.4 Auxiliary #6

Implements SSEM function code 3: a, S.

0	A	3 F	plant link	
1	T	10 θ		
2	H	3 H	compute store address from PI	form and plant appropriate operation order
3	C	58 F		
4	L	1 F		
5	A	8 H		
6	A	11 H	form and plant store order	
7	T	9 θ		
8	A	62 D	SSEM accumulator to accumulator	
9	(T	D)	SSEM accumulator to SSEM store	
10	(Z	F)	link	

4.2.5 Auxiliary #7

Implements SSEM function codes 4 and 5: $a - s, A$.

0	A	3 F	⎤	plant link
1	T	11 θ	⎦	
2	H	3 H	⎤	⎤
3	C	58 F		compute store address from PI ⎦ form and plant appropriate operation order
4	L	1 F		
5	A	8 H	⎦	
6	A	10 H	⎤	form and plant subtraction order ⎦
7	T	8 θ	⎦	
8	(S	D)		$-s$ to accumulator
9	A	62 D		SSEM accumulator $- s$ to accumulator
10	T	62 D		SSEM accumulator $- s$ to SSEM accumulator
11	(Z	F)		link

4.2.6 Auxiliary #8

Implements SSEM function code 6, which skips the next instruction if the contents of the SSEM accumulator are less than zero.

0	A	3 F	⎤	plant link
1	T	9 θ	⎦	
2	A	62 D		SSEM accumulator to accumulator
3	E	8 θ		return if ≥ 0
4	T	F		clear accumulator
5	A	60 D	⎤	
6	A	6πH		increment CI
7	T	60 D	⎦	
$3 \rightarrow 8$	T	F		clear accumulator
9	(Z	F)		link

4.2.7 Auxiliary #9

Implements SSEM function code 7, which halts the machine.

0	Z	F