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MYSTIC TRACER

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GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

AOPB SYSTEMS MANUAL
Program Description

MYSTIC TRACER

by

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September, 1964

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I. Program Objective and General Description

Mystic Tracer

The Mystic Tracer program is used to debug programs by tracing specified sequences of Mystic commands as they are executed. The contents of locations and results from the execution of commands are listed from tape. The Mystic Tracer uses the IBM 1401 Bumper program to prepare the program to be traced plus all of its subroutines.

The job is set up in two steps. The Tracer is set up as a subroutine which is called at the point in the sequence of commands at which the user desires tracing to begin. Thus, a function command must be inserted in the user's program at this point and the Tracer deck must be K'd and added onto the user's program. In the first step, the entire program to be traced is written on tape by the IBM 1401 Bumper program. The main program plus all subroutines that might be traced (included within the sequence of traced commands) must go onto this tape. The function command calling the Tracer must be inserted before step 1, but the Tracer (as a subroutine) need not be added to go onto this tape. In the second step, the program to be traced is compiled with the function command inserted to call the Tracer. The user's program, all subroutines to be traced, and the Tracer subroutine are compiled and execution continues until the Mystic function command calling the Tracer is executed. At this point, the Mystic Tracer takes over and continues to execute the instructions in the sequential order set by the logic of the user's program, but simultaneously records information about the execution of each command (arguments, results, et cetera). This tracing calls the tape generated in the 1401 step and continues until the Begin command specified in the function command calling the tracer is reached. At this point, control is returned to the main program and execution continues.

II. 1401 Bumper

Program Objective

This program adds the contents of the K counter to each address in a Mystic command—except those which have been Q'ed. The contents of the K counter are set to zero when a K00000 is encountered. Any other K is cumulatively added into the K counter.

In addition, this program has a feature necessary for tracing function commands with the tracing program. A record count is printed in columns 66-70 of each record containing a function command.

The 1401 bumper will accept Mystic commands from card or tape. For card input, sense switch C should be "on." For tape input, sense switch C should be "off" and the input tape is read from unit #1. This program makes a BCD tape on unit #2 which is input on B-4 for tracing.

III. Mystic Tracer

Program Objective

This program is used in debugging. It traces each command executed within bounds set by the user. All Mystic commands will be traced at present except for the following commands: Note, Load, and Execute. Also, this program can not yet trace a variable end (a transfer command that transfers to different Begin commands at successive executions of the transfer command. Example:

```
G 00100 00050 00060  
E 00100
```

where the location equal to 50 plus the contents of location 60 contains a Begin command).

As each command to be traced is executed, the Mystic command (operation code, X-address, Y-address, Z-address, and any other parameters) is written on tape along with information about the contents of the locations.

The Tracer is functioned to and the program can continue after the desired commands have been traced.

Program Requirements

The Mystic Tracer is a subroutine and should be placed behind all other subroutines of the program to be traced. It uses 380 memory locations. The first Q card must be filled in by the user:

```
Q 90040 XXXXX
```

where XXXXX equals K plus 1 (one)-(equals the location of the first Begin command of the Tracer).

A BCD tape of the program to be traced (including the function command calling the Tracer) plus all subroutines used by it should be made

using the 1401 Bumper Program. This tape is input to the Tracer program on tape unit B-4 during tracing.

A blank tape on B-5 is used by the Tracer for output. This tape should be listed to follow the execution of commands after the run.

Both for making the input tape and running the program, a function command should be inserted where the user wants tracing to begin.

F XXXXX YYYYY ZZZZZ

where XXXXX = 00000
YYYYY = the location of the first Begin command of the Tracer
ZZZZZ = the Begin command (in the program to be traced) where tracing should stop. The Tracer will execute and trace all commands in the flow of command sequence until this Begin command is reached.

Example: The Tracer is K'ed to 00500 and the user wishes to trace a section of his program starting with M 00080 00081 00082 and ending with B 00005.

```
      .  
      .  
      .  
      .  
      *B 00011  
      D 00040 00041 00042  
      → M 00080 00081 00082  
      .  
      .  
      .  
      .  
      R 00440 00441  
      G 00040 00050 00100  
      C 00040 00200 00005  
      E 00011  
      *B 00005
```

The following function command should be inserted before the Multiply command:

F 00000 00501 00005

The program plus subroutines, but not the Tracer deck, is put on tape with the IBM 1401 Bumper program. Then the K card and Tracer are put behind this deck for the machine run.

When F 00000 00501 00005 is executed, tracing begins with M 00080 00081 00082 and continues until C 00040 00200 00005, or some other command, transfers control to B 00005.

More than one section of the program can be traced by inserting other such function commands.

IV. Sample Output

```

DP  X      Y      Z      Y+(Z)      (Y+(Z))
G 00078 00050 00005 50000000 02 10000000 01

DP  X      Y      Z      (X)      (Y)      (Z)
M 00080 00008 00078 30000000 01 30000000 01 10000000 01

DP  X      Y      Z      (X)      (Y)      (Z)
M 00084 00078 00078 10000000 01 10000000 01 10000000 01

DP  X      Y      Z      (X)      (Y)      (Z)
M 00085 00007 00084 40000000 01 40000000 01 10000000 01

DP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00080 00080 00085 70000000 01 30000000 01 40000000 01

DP  X      Y      Y      (X)      (Y)      (Z)
M 00084 00078 00084 10000000 01 10000000 01 10000000 01

DP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00080 00080 00084 80000000 01 70000000 01 10000000 01

DP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00080 00080 00006 23000000 02 80000000 01 15000000 02

DP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00082 00080 00082 23000000 02 23000000 02 00000000 00

DP  X      Y      Z      (Z)
F 00090 09748 00080 23000000 02

DP  X      Y      Z      (Z)
F 00092 09748 00082 23000000 02

DP  X      Y      Z      (Z)
F 00088 09748 00078 10000000 01

DP  X      Y      Z      COLUMNS PER FIELD
P 00088 00009PA 09030903 09030000 00000000 00000000 0000
WAY DATA IS STORED
NNNNNN
(Y)      (X)
10000000 01 10000000 01

DP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00005 00005 00009 10000000 01 00000000 00 10000000 01

```

```

OP  X      Y      Z      (X)      (Y)
C 00010 0C0C5 0C0C1 20C00C0 02 10C00000 01

OP  X
B 00001

OP  X      Y      Z      Y+(Z)      (Y+(Z))
G 0C078 0C050 0C0C5 510C00C0 02 20C00000 01

OP  X      Y      Z      (X)      (Y)      (Z)
M 0C08C 0C008 0C078 60C00C0 01 30C00000 01 20000000 01

OP  X      Y      Z      (X)      (Y)      (Z)
M 00084 0C078 0C078 40C00C0 01 20C00000 01 20000000 01

OP  X      Y      Z      (X)      (Y)      (Z)
M 00085 0C0C7 0C084 160C00C0 02 40000000 01 40000000 01

OP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 0C080 00080 0C085 220C00C0 02 60000000 01 16000000 02

OP  X      Y      Y      (X)      (Y)      (Z)
M 0C084 00078 0C084 80C00C0 01 20C00000 01 40000000 01

OP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00080 0C080 0C084 30C000C0 02 220000C0 02 80000000 01

OP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 00080 0C080 0C0C6 450C00C0 02 30C00000 02 15000000 02

OP  X      Y      Z      (Y)+(Z)      (Y)      (Z)
A 0C082 0C080 0C082 680C00C0 02 45000000 02 23000000 02

OP  X      Y      Z      (Z)
F 0C09C 09748 0C080 450C00C0 02

OP  X      Y      Z      (Z)
F 00092 09748 0C082 680C00C0 02

OP  X      Y      Z      (Z)
F 00088 09748 0C078 20C000C0 01

OP  X      Y      Z      COLUMNS PER FIELD:
P 0C088 0C0C9PA 090309C3 09030000 00000000 00000000 0000
WAY DATA IS STORED
NNNNNN

```

(Y) (X)
10000000 01 20000000 08

DP X Y Z (Y)+(Z) (Y) (Z)
A 00005 00005 00009 20000000 01 10000000 01 10000000 01

DP X Y Z (X) (Y)
C 00010 00005 00001 20000000 02 20000000 01

DP X
B 00001

DP X Y Z Y+(Z) (Y+(Z))
G 00078 00050 00005 52000000 02 30000000 01

DP X Y Z (X) (Y) (Z)
M 00080 00008 00078 90000000 01 30000000 01 30000000 01

DP X Y Z (X) (Y) (Z)
M 00084 00078 00078 90000000 01 30000000 01 30000000 01

DP X Y Z (X) (Y) (Z)
M 00085 00007 00084 36000000 02 40000000 01 90000000 01

DP X Y Z (Y)+(Z) (Y) (Z)
A 00080 00080 00085 45000000 02 90000000 01 36000000 02

DP X Y Y (X) (Y) (Z)
M 00084 00078 00084 27000000 02 30000000 01 90000000 01

DP X Y Z (Y)+(Z) (Y) (Z)
A 00080 00080 00084 72000000 02 45000000 02 27000000 02

DP X Y Z (Y)+(Z) (Y) (Z)
A 00080 00080 00006 87000000 02 72000000 02 15000000 02

DP X Y Z (Y)+(Z) (Y) (Z)
A 00082 00080 00082 15500000 03 87000000 02 68000000 02

DP X Y Z (Z)
F 00090 09748 00080 87000000 02

DP X Y Z (Z)
F 00092 09748 00082 15500000 03

DP X Y Z (Z)
F 00088 09748 00078 30000000 01

DP X Y Z COLUMNS PER FIELD
 P 00088 000C9PA 09030903 C9C30000 00000000 00000000 0000
 WAY DATA IS STCRED
 NNNNNN

(Y) (X)
 1000000 01 30000000 08

DP X Y Z (Y)+(Z) (Y) (Z)
 A 00005 00005 00009 30000000 01 20000000 01 10000000 01

DP X Y Z (X) (Y)
 C 00010 00005 00001 20000000 02 30000000 01

DP X
 B 00001

DP X Y Z Y+(Z) (Y+(Z))
 G 00078 00050 00005 53000000 02 40000000 01

DP X Y Z (X) (Y) (Z)
 M 00080 00008 00078 12000000 02 30000000 01 40000000 01

DP X Y Z (X) (Y) (Z)
 M 00084 00078 00078 16000000 02 40000000 01 40000000 01

DP X Y Z (X) (Y) (Z)
 M 00085 00007 00084 64000000 02 40000000 01 16000000 02

DP X Y Z (Y)+(Z) (Y) (Z)
 A 00080 00080 00085 76000000 02 12000000 02 64000000 02

DP X Y Z (X) (Y) (Z)
 M 00084 00078 00084 64000000 02 40000000 01 16000000 02

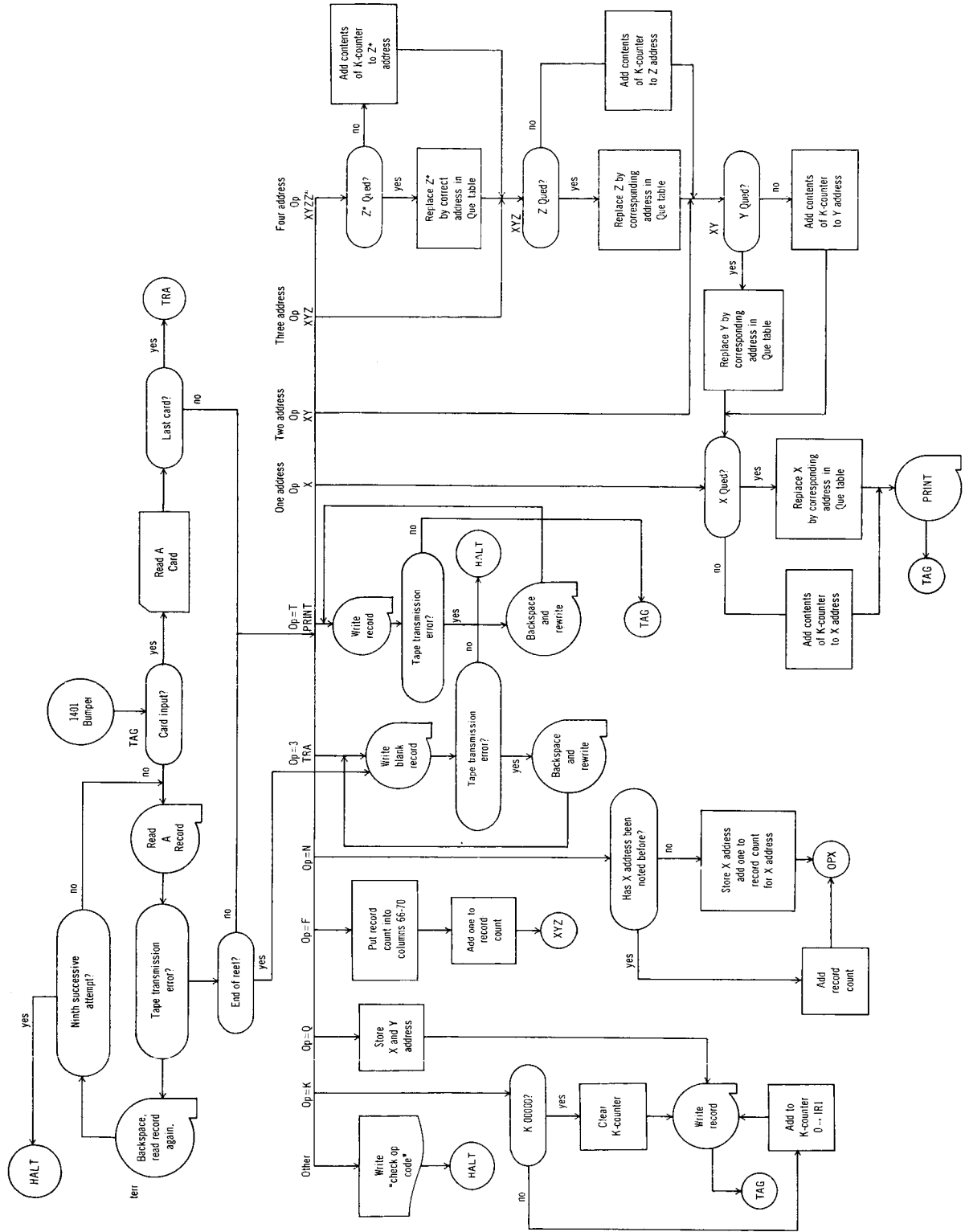
DP X Y Z (Y)+(Z) (Y) (Z)
 A 00080 00080 00084 14000000 03 76000000 02 64000000 02

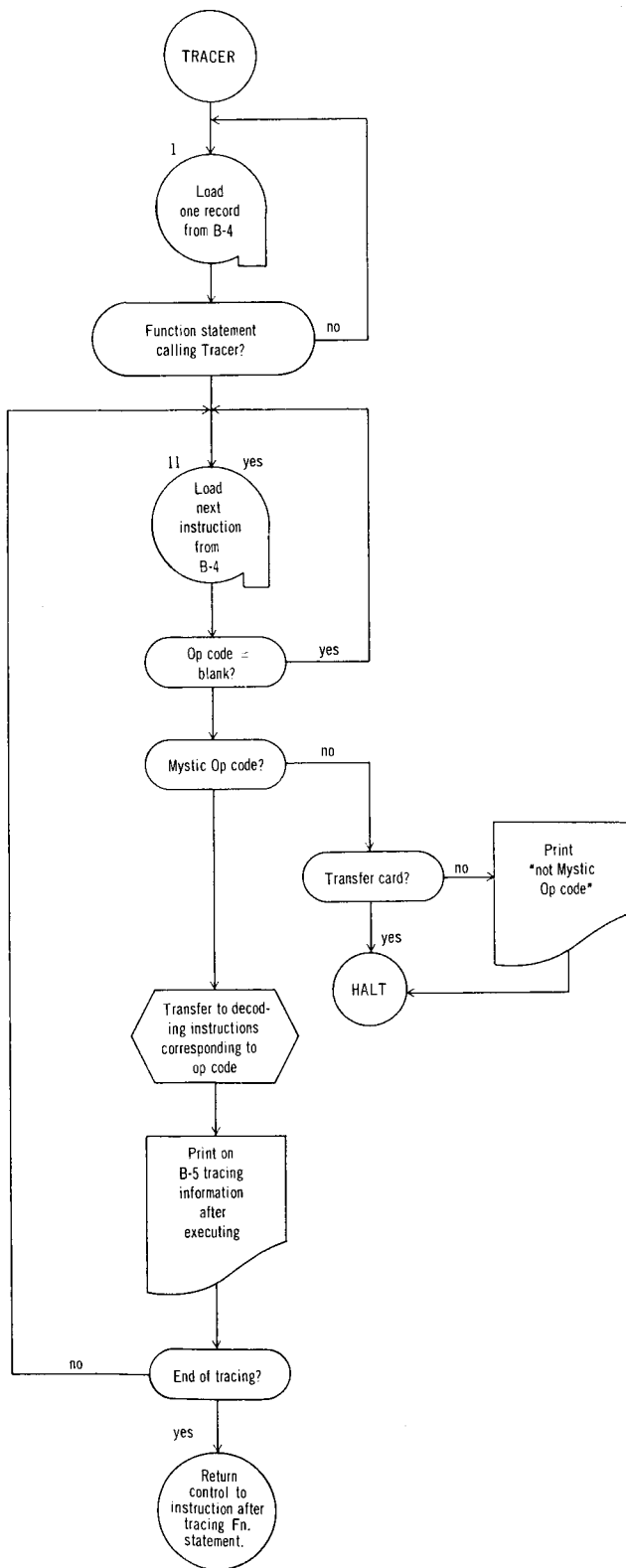
DP X Y Z (Y)+(Z) (Y) (Z)
 A 00080 00080 00006 15500000 03 14000000 03 15000000 02

DP X Y Z (Y)+(Z) (Y) (Z)
 A 00082 00080 00082 31000000 03 15500000 03 15500000 03

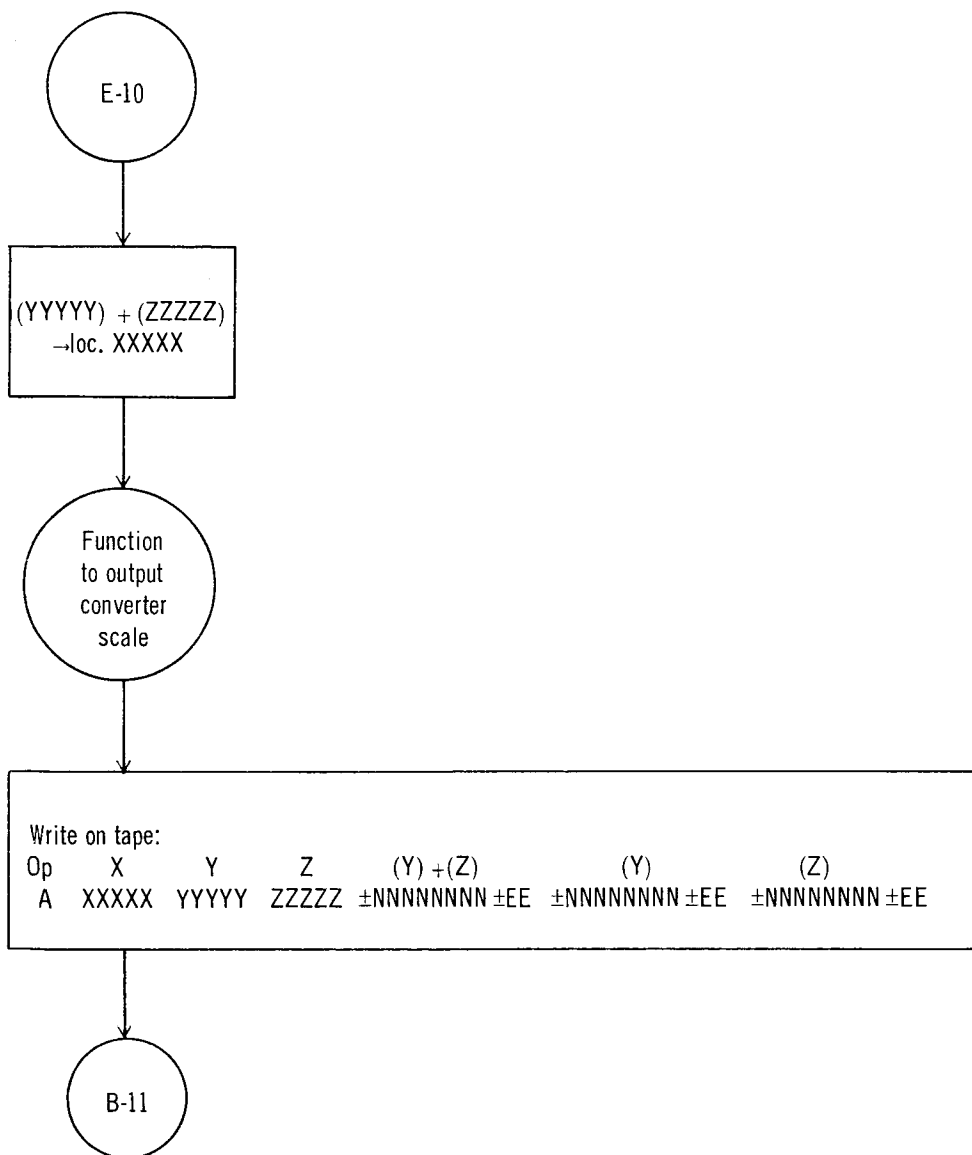
DP X Y Z (Z)
 F 00090 09748 00080 15500000 03

DP X Y Z (Z)





Sample Decoding Instructions: Add Op (A XXXXX YYYYY ZZZZ)



MYSTIC STORAGE MAP

MYSTIC PROGRAM NO. _____

PAGE 1 OF 4

DESCRIPTION: Tracing Program

Uses Locations 1 to 379

PROGRAMMER: Patricia Brown Savage

00		B	Transfer to Next Instruction	[Z - Y]	[X - Y]
05	(Z)	-2	B	B	B
10	Variable End	B	B	B	B
15	B	B	B	B	
20	B	B			
25	B	B	B		B
30	φ	89	The Letter B	The Letter N	61
35		30,000	Return From Tracer		61,000,000
40	B	B	B	B	B
45	B		B		
50	OP	X	Y	Z	
55					
60					
65	-1	+1	160	3	700,000
70	63,000	6,400	7,800	9,000	
75	75	90	8,300	10,000	80
80	2	4	5	6	3
85	100	Note Counter	Counter	9,748	
90					
95	The Letter F			Working Storage	

NOTES:

MYSTIC STORAGE MAP

MYSTIC PROGRAM NO. _____

PAGE 2 OF 4

DESCRIPTION: Tracing Program

Uses Locations 1 to 379

PROGRAMMER: Patricia Brown Savage

1, 00	00	01	02	03	04
1, 05	05	06	07	08	09
1, 10	10	11	12	13	14
1, 15	15	16	17	18	19
1, 20	20	21	22	23	24
1, 25	25	26	27	28	29
1, 30	30	31	32	33	34
1, 35	35	36	37	38	39
1, 40	40	41	42	43	44
1, 45	45	46	47	48	49
1, 50	50	51	52	53	54
1, 55	55	56	57	58	59
1, 60	60	61	62	63	64
1, 65	65	66	67	68	69
1, 70	B	B _A	B _B	B _C	B _D
1, 75	B _E	B _F	B _G	B _H	B _I
1, 80	B	B _J	B _K	B _L	B _M
1, 85	B _N	B _O	B _P	B _Q	B _R
1, 90	Z	1050	B _S	B _T	B _U
1, 95	B _V	B _W	B _X	B _Y	B _Z

NOTES:

MYSTIC STORAGE MAP

MYSTIC PROGRAM NO. _____

PAGE 3 OF 4

DESCRIPTION: Tracing Program

Uses Locations 1 to 379

PROGRAMMER: Patricia Brown Savage

2,00	B	00	B	01	Variable End To Zero	02	Storing Notes	03	Storing Notes	04
2,05	Storing Notes	05	Storing Notes	06	Storing Notes	07	Storing Notes	08	Storing Notes	09
2,10	Storing Notes	10	B	11	B	12	Working Storage	13	B	14
2,15	B	15	B	16	B	17	B	18	B	19
2,20	B	20	B	21	B	22	B	23	B	24
2,25	B	25	B	26	B	27	B	28	B	29
2,30	B	30	B	31	B	32	B	33		34
2,35		35		36		37		38		39
2,40		40		41		42		43		44
2,45		45		46		47		48		49
2,50	OUTPUT SCALE CONVERTER					52		53	→	
2,55		55		56		57		58		59
2,60		60		61		62		63		64
2,65		65		66		67		68		69
2,70		70		71		72		73		74
2,75		75		76		77		78		79
2,80		80		81		82		83		84
2,85		85		86		87		88		89
2,90		90		91		92		93		94
2,95		95		96		97		98		99

NOTES:

MYSTIC STORAGE MAP

MYSTIC PROGRAM NO. _____

PAGE 4 OF 4

DESCRIPTION: Tracing Program

Uses Locations 1 to 379

PROGRAMMER: Patricia Brown Savage

3 00	00	01	02	03	04
	OUTPUT SCALE	CONVERTER	→		
3 05	05	06	07	08	09
3 10	10	11	12	13	14
3 15	15	16	17	18	19
3 20	20	21	22	23	24
3 25	25	26	27	28	29
3 30	30	31	32	33	34
3 35	35	36	37	38	39
3 40	40	41	42	43	44
3 45	45	46	47	48	49
3 50	50	51	52	53	54
3 55	55	56	57	58	59
3 60	60	61	62	63	64
3 65	65	66	67	68	69
3 70	70	71	72	73	74
3 75	75	76	77	78	79
80	80	81	82	83	84
85	85	86	87	88	89
90	90	91	92	93	94
95	95	96	97	98	99

NOTES:

CLEAR STORAGE 1 ,C08015,C22026,030034,C41,045,053,0570731026
 CLEAR STORAGE 2 L072116,110106,1651170101/199,C27AC74028)027B0010270BC26/0991,001/00111710
 BOOTSTRAP CARD ,C08015,C22029,05606J/C56029 ,0240671056

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS
1	010			CIL	231					
1	020			ORG	3C00					
1	150	7		SW	0801	0802		3000	, 801 802	
1	152	4		SW	NCTECT+002			3007	, 197	
1	160	4		SW	0340			3011	, 340	
1	170	7		SW	0087	0092		3015	, 097 092	
1	180	4		SW	CC01			3022	, 001	
2	060	4	TAG	H	READ			3026	B 050	
2	070	8		B	CPK	0801	K	3030	B C46 801 K	
2	080	8		B	CPQ	0801	G	3038	B 073 801 Q	
2	090	8		H	XYZ	0801	C	3046	B 058 801 C	
2	100	8		B	CPF	0801	F	3054	H H13 801 F	
2	110	8		B	XYZ	0801	G	3062	R 058 801 G	
2	120	8		B	XYZ	0801	H	3070	B 058 801 H	
2	130	8		B	X	0801	B	3078	H E18 801 B	
2	140	8		H	X	0801	E	3086	B E18 801 E	
2	150	8		B	XY	0801	L	3094	B 088 801 L	
2	160	8		H	XY	0801	P	3102	B 088 801 P	
2	170	8		H	XYZZ	0801	C	3110	B 028 801 C	
2	180	8		B	XYZ	0801	A	3118	B 058 801 A	
2	190	8		B	XYZ	0801	D	3126	B 058 801 D	
2	200	8		B	XYZ	0801	M	3134	B 058 801 M	
2	210	8		B	XYZ	0801	S	3142	H 058 801 S	
2	220	8		B	CPN	0801	N	3150	H H48 801 N	
2	230	8		B	X	0801	V	3158	B E18 801 V	
2	240	8		H	X	0801	I	3166	B E18 801 I	
2	250	8		B	X	0801	W	3174	R E18 801 W	
2	260	8		J	PRINT	0801	T	3182	B G25 801 T	
2	270	8		H	XY	0801	R	3190	B 088 801 R	
2	280	8		C	PRINT	0801	D	3198	B G25 801 D	
2	290	8		B	X	0801	J	3206	B E18 801 J	
2	300	8		B	X	0801	X	3214	B E18 801 X	
2	310	8		B	TRA	0801	3	3222	B F72 801 3	
2	320	8		B	PRINT	0801		3230	B G25 801	
2	322	8		H	PRINT	0801	.	3238	B G25 801 .	
2	325	4		B	OTHER			3246	H H31	
2	330	4	READ	SPR	EXIT + 3			3250	H B87	
3	020	5	RETURN	S	READC		C	3254	B C12 C	
3	030	7	READ1	LCA	ZERD -003	HSPK		3259	L 162 176	
3	040	8	READT	MCW	(LI	0801	R	3266	M (U1 801 R	
3	050	5		B	TERR		L	3274	B 088 L	
3	060	5		B	TRA		K	3279	B F72 K	
3	120	4	EXIT	B	OC00			3284	B 000	
3	130	5	TERR	CL	(LI		B	3288	U (U1 B	
3	140	7		A	CNE	BSPK		3293	A 171 176	
3	150	8		B	PRINT	BSPK	9	3300	B G25 176 9	
3	160	4		B	READT			3308	H H66	
3	170	1	READC	R				3312	L	
3	180	7		MCM	CC01	0801		3313	P 001 801	
3	185	5		B	TRA		A	3320	B F72 A	
3	190	4		B	EXIT			3325	B B94	

PG	LN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS
4	010	4	PRINTE	CS	C332			3329	/	332
4	015	4		CS	C300			3333	/	300
4	020	7		LCA	C918	0201		3337	L	918 201
4	030	1		H				3344	2	
4	040	1		H				3345	.	
4	045	4	DPK	CS	C799			3346	/	799
4	050	1		CS				3350	/	
4	060	7		C	ZERO	0806		3351	C	165 806
4	065	4		CS	1109			3359	/	09
4	070	5		H	KXZ		/	3362	B	C95 /
4	080	7		LCA	ZERO	-002	0089	3367	L	163 089
4	090	7		ZA	C806	0344		3374	+	806 344
4	130	4		B	PRINT			3381	B	G25
4	150	7	KXZ	A	C806	0344		3385	A	806 344
4	155	7		LCA	ZERO	-002	0089	3392	L	163 089
4	190	4		B	PRINT			3399	B	G25
4	200	7	DPW	LCA	C806	1104	1	3403	L	806 /+4
4	210	7		LCA	C811	1109	1	3410	L	811 /+9
4	220	7		A	TEN	0089		3417	A	174 089
4	260	4		B	PRINT			3424	B	G25
4	265	7	XYZZ	LCA	ZERO	-002	0094	3428	L	163 094
5	010	4		SW	C817			3435	,	817
5	030	7	CCMPC1	C	C821	1104	2	3439	C	821 /-4
5	040	5		B	NXTQ1		/	3446	B	E52 /
5	050	7		MCW	1109	2	0821	3451	M	/-9 821
5	055	7	XYZ	LCA	ZERO	-002	0094	3458	L	163 094
5	060	4		SW	C812			3465	,	812
5	070	7	CCMPC2	C	C816	1104	2	3469	C	816 /-4
5	080	5		B	NXTQ2		/	3476	B	E92 /
5	090	7		MCW	1109	2	0816	3481	M	/-9 816
5	095	7	XY	LCA	ZERO	-002	0094	3488	L	163 094
5	100	4		SW	C807			3495	,	807
5	110	7	CCMPC3	C	C811	1104	2	3499	C	811 /-4
5	120	5		H	NXTQ3		/	3506	B	F12 /
5	130	7		MCW	1109	2	0811	3511	M	/-9 811
5	135	7	X	LCA	ZERO	-002	0094	3518	L	163 094
5	140	4		SW	C802			3525	,	802
5	150	7	CCMPC4	C	C806	1104	2	3529	C	806 /-4
5	160	5		H	NXTQ4		/	3536	B	F42 /
5	170	7		MCW	1109	2	0806	3541	M	/-9 806
5	190	4		B	PRINT			3548	B	G25
6	010	7	NXTQ1	A	TEN	0094		3552	A	174 094
6	030	7		C	C894	0089		3559	C	094 089
6	040	5		B	CCMPQ1		U	3566	B	D39 U
6	045	7		A	C344	0821		3571	A	344 821
6	050	4		B	XYZ			3578	B	D58
6	060	7	NXTQ2	A	TEN	0094		3582	A	174 094
6	080	7		C	C894	0089		3589	C	094 089
6	090	5		B	CCMPQ2		U	3596	B	D69 U
6	095	7		A	C344	0816		3601	A	344 816
6	100	4		B	XY			3608	B	D88
6	110	7	NXTQ3	A	TEN	0094		3612	A	174 094
6	130	7		C	C894	0089		3619	C	094 089
6	140	5		B	CCMPQ3		U	3626	B	D99 U
6	145	7		A	C344	0811		3631	A	344 811
6	150	4		B	X			3638	B	E18

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS
6	170	7	NXT34	A	JEN	0094		3642	A I74 094	
6	190	7		C	CC94	0089		3649	C 094 089	
6	200	5		H	CCMPQ4		U	3656	H E29 U	
6	205	7		A	C244	0806		3661	A 344 806	
6	210	4		H	PRINT			3668	H G25	
7	100	7	TRA	LCA	GPMK	0875		3672	L I77 875	
7	110	8	ALPHAT	MCW	LU2	0801	W	3679	M LU2 801 W	
7	120	5		H	WERRT		L	3687	H 573 L	
7	121	4		CS	CR80			3692	/ 880	
7	122	7		LCA	GPMK	0875		3696	L I77 875	
7	123	8		MCW	LU2	0801	W	3703	M LU2 801 W	
7	125	5		CU	LU2		M	3711	U LU2 M	
7	127	5		CU	LU2		M	3716	U LU2 M	
7	130	4	HALT	H	HALT			3721	. G21	
7	210	7	PRINT	LCA	GPMK	0875		3725	L I77 875	
7	220	8	ALPHA	MCW	LU2	0801	W	3732	M LU2 801 W	
7	230	5		H	WERR		L	3740	B G49 L	
7	240	4		B	TAG			3745	B +26	
8	010	5	WERR	CU	LU2		B	3749	U LU2 B	
8	020	7		A	CNE	BSPKW		3754	A I71 I79	
8	030	8		B	PRINTW	BSPKW	5	3761	H G97 I79 5	
8	040	4		H	ALPHA			3769	B G32	
8	070	5	WERRT	CU	LU2		B	3773	U LU2 B	
8	080	7		A	CNE	HSPKWT		3778	A I71 I81	
8	090	8		H	PRINTW	BSPKWT	5	3785	B G97 I81 5	
8	100	4		B	ALPHAT			3793	B F79	
8	120	7	PRINTW	LCA	GPMK	1020		3797	L I77 +20	
8	130	8		MCW	LU2	1000	W	3804	M LU2 +00 W	
8	140	1		H				3812	.	
8	142	7	UPF	A	CNE	RCT		3813	A I71 I70	
8	143	7		LCA	RCT	0870		3820	L I70 870	
8	144	4		H	XYZ			3827	H 058	
8	150	4	OTHER	CS	C332			3831	/ 332	
8	160	4		CS	C300			3835	/ 300	
8	170	7		LCA	LC13	0201		3839	L #13 201	
8	180	1		W				3846	2	
8	190	1		H				3847	.	
8	192	7	OPV	SW	C802	0600		3848	, 802 600	
8	195	7		LCA	ZERO -002	0094		3855	L 163 094	
8	210	7	OPN2	C	CC94	0099		3862	C 094 099	
8	220	7		A	EIGHT	0094		3869	A I89 094	
8	223	5		J	STOREN		S	3876	B I22 S	
8	225	7		C	C596	2 0806		3881	C 586 806	
8	230	5		B	CPN2		/	3888	B H62 /	
8	231	4		SW	C605			3893	, 605	
8	233	7		A	NOTECT	0599	2	3897	A I95 589	
8	235	7		LCA	C596	2 0867		3904	L 586 867	
8	240	7		LCA	C599	2 0870		3911	L 589 870	
8	245	4		B	PRINT			3919	B G25	
8	255	7	STOREN	LCA	C806	0604	3	3922	L 806 6+4	
8	260	7		LCA	NOTECT	0607	3	3929	L I95 6+7	
8	270	7		LCA	C604	3 0867		3936	L 6+4 867	
8	280	7		LCA	C607	3 0870		3943	L 6+7 870	
8	285	7		A	EIGHT	0099		3950	A I89 099	
8	290	4		B	PRINT			3957	B G25	
9	030	5	ZERO	CCW	*		00000	3965		
9	035	5	RCT	CCW	*		00000	3970		

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION COMMENTS
9	040	1	ONE	CCW	*			1	3971
9	050	3	TEN	CCW	*			010	3974
9	060	2	BSPK	CCW	*			00	3976
9	070	19		CCW	0518	BAD RECORD ON TAPE		0918	
9	080	1	SPMK	CCW	*				3977
9	090	2	BSPKW	CCW	*			00	3979
9	100	2	BSPKW	CCW	*			00	3981
9	110	9		CCW	1000	BAD WRITE		1000	
9	190	1		CCW	0400			K	0400
9	200	1		CCW	0401			Q	0401
9	210	13		CCW	1013	CHECK OP CODE		1013	
9	215	5	STABLE	CCW	1100				1100
9	220	1	SHOS	CCW	CC81				0081
9	222	5	NRCT	CCW	*			00000	3986
9	223	3	EIGHT	CCW	*			008	3989
9	224	3	UNENTY	CCW	*			190	3992
9	225	3	NCTECT	CCW	*			001	3995
10	010	3		CCW	CC89			000	0089
10	020	3		CCW	CC94			000	0094
10	030	3		CCW	CC99			000	0099
99	999			END	1000				

/ +00 080

185 CARDS

K= 00000

MYSTIC TRACER

SEPTEMBER, 1962

TRACER USES 380 MEMORY LOCATIONS

Q 90041 09748
Q 90040 01001
Q 90043 02651
Q 90047 00001
Q 90045 00002
Q 90046 00003
Q 90050 00000
Q 90042 00000
W 00032 B
W 00033 N
W 00095 F
V 00006 -20000000+01
V 00030 +00000000+00
V 00031 +89000000+02
V 00034 +61000000+02
V 00036 +30000000+05
V 00039 +61000000+08
V 00065 -10000000+01
V 00066 +10000000+01
V 00067 +16000000+03
V 00068 +30000000+01
V 00069 +70000000+06
V 00070 +63000000+05
V 00071 +64000000+04
V 00072 +78000000+04
V 00073 +90000000+04
V 00075 +75000000+02
V 00076 +90000000+02
V 00077 +83000000+04
V 00078 +10000000+05
V 00079 +80000000+02
V 00080 +20000000+01
V 00081 +40000000+01

LOC OUTPUT CONVERTER OF USER
TO BE FILLED IN BY USER (K + 1)

(THE LETTER F)

K= 00000

V 00082 +50000000+01
V 00083 +60000000+01
V 00084 +30000000+01
V 00085 +10000000+03
V 00086 +00000000+00
V 00087 +00000000+00
V 00088 +97480000+04
V 00191 +24900000+03
*B 00001
L 00050 00066 TF 01050505 ANNN
C 00050 00095 00001 00001 IS @P = F
G 00098 90042 00052
C 00098 90040 00001 00001
G 00005 90040 00003 YES
G 00054 90042 00053
C 00005 00054 00001 00001 DOES Z @N TAPE = Z @F FN STATEMENT
A 00191 00191 00052
R 00190 00053
*B 00011 LOAD NEXT INSTRUCTION AFTER TRACER FN STATEMENT
L 00050 00066 TF 0105050505 ANNNN
C 00050 00030 00014 00014 IS @P EQUAL TO BLANK
F 00011
*B 00014
C 00050 00031 00012 IS @P CODE = LETTER
C 00034 00050 00012 IS @P CODE = LETTER
G 00010 00110 00050
F 00010 VARIABLE END
*B 00171 @P = A
G 00058 90042 00053
G 00056 90042 00052
A 00054 00056 00058
H 90042 00051 00054
F 00054 90041 00054
F 00056 90041 00056
F 00058 90041 00058
T@P X Y Z (Y)+(Z) (Y) (Z)
P 00030 00066 TG
T
P 00050 00066 TG 01060606090309030903 ANNNNNNNNN
F 00011
*B 00018
T@P DOES NOT EQUAL A MYSTIC @P CODE LIST OUTPUT TAPE
P 00000 00066 PA

K= 00000

TOP DOES NOT EQUAL A MYSTIC OP CODE

P 00000 00066 TG
F 00030
*R 00012
C 00050 00084 00018 00018
TTRANSFER CARD HALT
P 00030 00066 PA
F 00030
*R 00173
C 00054 00030 00009 00009 C OR C STAR
G 00054 90042 00051
G 00056 90042 00052
C 00054 00056 00015
*R 00016
F 00054 90041 00054
F 00056 90041 00056
TOP X Y Z (X) (Y)
*R 00228
P 00030 00066 TG
T
P 00050 00066 TG 0106060609030903 ANNNNNNN
F 00011
*R 00015 GREATER THAN
F 00056 90041 00056
F 00054 90041 00054
TOP X Y Z (X) (Y)
P 00030 00066 TG
T
P 00050 00066 TG 0106060609030903 ANNNNNNN
P 00030 00065 TF REWIND TAPE
*R 00047
C 00066 00087 00007 ANY FUNCTION STATEMENTS YET
G 00098 00110 00087
C 00098 00053 00007 00007
G 00098 00111 00087
S 00087 00087 00080
*R 00045
L 00050 00066 TF 151515150505 SSSSSN
C 00050 00098 00045 00045
TRETURN FROM FUNCTION RECORD MARK EQUALS
P 00050 00066 TG 15151105 SSSN
F 00011

```

*B 00007
G 00098 90042 00053
R 00055 00030
C 00098 00030 00201 00201
G 00202 90042 00053
    THALT TRANSFER TO A LOCATION THAT CONTAINS ZERO
P 00000 00066 TG
P 00000 00066 PA
F 00202
*B 00223
    TOP      X
P 00030 00066 TG
*B 00180
    T
P 00050 00066 TG      0106                      AN
F 00011
*B 00008
L 00000 00098 TF      BACKSPACE N RECORDS
F 00223
*B 00217      SEARCH FOR NEXT BEGIN
L 00058 00066 TF      0105                      AN
A 00098 00065 00098
C 90050 00006 00224 00224
L 00000 00098 TF      BACKSPACE N RECORDS
F 00223
*B 00009      C STAR
G 00055 90042 00051
G 00057 90042 00052
C 00055 00057 00013 00021
F 00055 90041 00055
F 00057 90041 00057
    TOP      X      Y      Z      Z STAR      (X)      (Y)
P 00030 00066 TG
    T
P 00050 00066 TG      010606060609030903      ANNNNNNNNN
F 00011
*B 00013      GREATER THAN
F 00055 90041 00055
F 00057 90041 00057
    TOP      X      Y      Z      Z STAR      (X)      (Y)
P 00030 00066 TG
    T
P 00050 00066 TG      010606060609030903      ANNNNNNNNN

```

K= 00000

P 00030 00065 TF REWIND TAPE
F 00047
*B 00021 LESS THAN

R 00053 00054
F 00013
*B 00174
G 00058 90042 00053
G 00056 90042 00052
D 00054 00056 00058
H 90042 00051 00054
*B 00025
F 00054 90041 00054
F 00056 90041 00056
F 00058 90041 00058

T@P X Y Z (X) (Y) (Z)

*B 00229
P 00030 00066 TG

T
P 00050 00066 TG 01060606090309030903 ANNNNNNNNN

F 00011
*B 00177
G 00056 90042 00053
A 00054 00056 00052
G 00056 90042 00054
H 90042 00051 00056
F 00054 90041 00054
F 00056 90041 00056
F 00058 90041 00058

T@P X Y Z Y+(Z) (Y+(Z))

F 00228
*B 00178
G 00056 90042 00052
G 00058 90042 00053
A 00054 00051 00056
H 90042 00054 00058
F 00054 90041 00054
F 00056 90041 00056
F 00058 90041 00058

T@P X Y Z X+(Y) (Y) (Z)

F 00229
*R 00192
G 00056 90042 00052

G 00058 90042 00053
 S 00054 00056 00058
 H 90042 00051 00054
 F 00025
 *R 00184
 G 00056 90042 00052
 G 00058 90042 00053
 M 00054 00056 00058
 H 90042 00051 00054
 E 00025
 *B 00175
 TOP X
 P 00030 00066 TG
 T
 P 00050 00066 TG 0106 AN
 P 00030 00065 TF REWIND TAPE
 R 00053 00051
 F 00047
 *R 00172
 TOP X
 P 00030 00066 TG
 T
 P 00050 00066 TG 0106 AN
 C 00051 00190 00011 00011 IS IT TIME TO STOP TRACING
 TEND OF TRACING RETURN TO PROGRAM AT THIS BEGIN
 P 00030 00066 TG
 G 00037 90042 00051
 F 00037
 *R 00182
 TOP X ALL ADDRESSES HAVE BEEN KED AND QED BY 1401 PROGRAM
 P 00030 00066 TG
 F 00180
 *B 00179
 L 00030 00065 TF REWIND ONE RECORD
 L 00050 00066 TF 01050903 ANNN
 F 00055 90043 00052
 H 00000 00051 00055
 TOP X VALUE
 *B 00230
 P 00030 00066 TG
 T
 P 00050 00066 TG 01060903 ANNN
 F 00011

K= 00000

*B 00188
TOP X Y ALL ADDRESSES HAVE BEEN KED AND QED BY 1401 PROGRAM
P 00030 00066 TG
T
P 00050 00066 TG 010606 ANN
F 00011
*B 00189
G 00053 90042 00052
G 00055 90042 00051
H 90042 00051 00053
F 00053 90041 00053
F 00055 90041 00055
E 00027
*B 00193
TTITLE COMMAND
P 00030 00066 TG
E 00011
*B 00194 UNPACK
G 00057 90042 00052
U 00057 00057
H 90042 00051 00057
F 00055 90041 00057
F 00053 90041 00052
*B 00027
TOP X Y (Y) BEFORE (X) AFTER
P 00030 00066 TG
T
P 00050 00066 TG 01060609030903 ANNNNNN
E 00011
*B 00195
F 00011
*B 00196
E 00011
*B 00185
TNOTE COMMAND THE TRACER WILL NOT TRACE NOTE
P 00030 00066 TG
T
P 00050 00066 TG 0106 AN
F 00011
*B 00187
L 00030 00065 TF
L 00053 00066 TF 1103020808080804 SASNNNNN

K= 00000

	TOP	X	Y	Z	COLUMNS PER FIELD	
P	00030	00066	TG			
	T					
P	00050	00066	TG		0106060309090905	ANNANNNNN
L	00030	00065	TF		BACKSPACE ONE RECORD	
L	00055	00066	TF		1515150704040402	SSSSAAAAA
	T	WAY DATA IS	STORED			
P	00030	00066	TG			
	T					
P	00055	00066	TG		030404040402	SAAAAA
G	00050	90042	00052			
C	00066	00050	00040			
	T	(Y)		(X)		
C	00055	00039	00029			
G	00052	90042	00051			
F	00050	90041	00050			
*B	00232					
P	00030	00066	TG			
	T					
P	00050	00066	TG		090304	NNA
F	00011					
*B	00029					
G	00052	90042	00051			
F	00050	90041	00050			
F	00052	90041	00052			
*B	00231					
	T	(Y)		(X)		
P	00030	00066	TG			
	T					
P	00050	00066	TG		09030903	NNNN
F	00011					
*B	00040					
C	00050	00030	00041	00041		
	T	(Y)	WRITE AN END	OF FILE MARK	ON APPROPRIATE TAPE	
P	00030	00066	TG			
	T					
F	00050	90041	00050			
R	00052	00053				
P	00050	00066	TG		090315150603	NNSSSA
E	00011					
*B	00041					
	T	(Y)	REWIND THE	APPROPRIATE	TAPE	
P	00030	00066	TG			

```

      T
F 00050 90041 00050
R 00052 00053
P 00050 00066 TG      0903150603      NNSSA
F 00011
*B 00183
L 00030 00065 TF
L 00053 00066 TF      110302060606150304040402      SASNNSSAAAAA
      TOP X Y Z      COLUMNS PER FIELD WAY DATA IS STORED
P 00030 00066 TG
      T
P 00050 00066 TG      0106060306060604040402      ANNANNNAAAAA
G 00050 90042 00052
C 00066 00050 00042
      T (Y) (X)
C 00057 00039 00043
G 00052 90042 00051      T1=A
F 00050 90041 00050
F 00232
*B 00043      T1=N
G 00052 90042 00051
F 00050 90041 00050
F 00052 90041 00052
E 00231
*B 00042
C 00050 00030 00044 00044
      T (Y) BACK SPACE A FILE
F 00233
*B 00044
      T (Y) BACK SPACE N RECORDS
*B 00233
P 00030 00066 TG
      T
F 00050 90041 00050
P 00050 00066 TG      0903      NN
F 00011
*B 00176      FUNCTION COMMAND
G 00098 90042 00052
C 00098 90040 00212 00212
F 00011
*B 00212
      TOP X Y Z (Z)

```



```

P 00030 00066 TG
G 00054 90042 00053
F 00054 90041 00054
  T
P 00050 00066 TG      010606060903      ANNNNN
C 00052 00088 00170 00170      IS IT THE OUTPUT SCALE FN
S 00252 00053 00191
S 00253 00051 00191
F 00250      GO TO OUTPUT SCALE
*B 00170      FN IS NOT OUTPUT SCALE
L 00030 00065 TF
L 00054 00066 TF      151515150505      SSSSSN
S 00098 00053 00052
H 90045 00052 00098      Z MINUS Y INTO K + 3
S 00098 00051 00052
H 90046 00052 00098      X MINUS Y INTO K + 4
H 90047 00052 00054      RECORD MARK GOES INTO K + 2
P 00030 00065 TF
*B 00200
L 00055 00066 TF      0105      AN
C 00055 00032 00200 00200      SEARCHING FOR OP EQUAL TO B
C 00056 00052 00200 00200      SEARCH FOR RIGHT FUNCTION
  T X EQUALS X OF FUNCTION STATEMENT      SEARCH FOR RIGHT FUNCTION
P 00030 00066 TG
  TOP X
P 00030 00066 TG
  T
P 00055 00066 TG      0106      AN
H 00110 00087 00052
H 00111 00087 00054
A 00087 00087 00080
F 00011
*B 00201
L 00050 00066 TF      0105      AN
C 90050 00006 00222 00222
  TRIGHT BEGIN CAN NOT BE FOUND      HALT
P 00000 00066 TG
P 00000 00066 PA
F 00030
*B 00222
C 00032 00050 00201 00201
C 00051 00053 00201 00201
F 00223

```

K= 00000

K 00249
Q 90011 00811
*B 00001
I 00005 +10000000+01
I 00006 +10000000+02
I 00007 +67108864+08
A 00007 00007 00007
I 00008 +00000000+00
D 00009 00005 00007
I 00011 +45000000+02
H 00030 00008 00009
N 00001
A 00008 00008 00005
M 00009 00009 00006
H 00030 00008 00009
C 00011 00008 00001
I 00005 +00000000+00
I 00006 +67108864+08
A 00006 00006 00006
I 00007 +10000000+01
I 00008 +70000000+01
I 00009 +50000000+01
N 00001
V 00017 +10000000+09
V 00018 +99999999+07
V 00019 +80000000+01
G 00010 00001 00003
A 00010 00005 00010
I 00025 +10000000+01
C 00010 00005 00020
S 00010 00005 00010
I 00025 -10000000+01
C 00010 00005 00020
*B 00129
H 00001 00004 00005
H 00002 00004 00005
E 90011
*B 00020
C 00007 00010 00022
F 00012 00076 00010
C 00012 00008 00021
S 00011 00008 00012

OUTPUT CONVERTER USES LOCATIONS 1 TO 128

K= 00249

G 00013 00030 00011
M 00014 00010 00013
M 00015 00014 00006
A 00012 00012 00007
E 00023
*B 00021
S 00011 00012 00008
G 00013 00030 00011
D 00014 00010 00013
D 00015 00014 00006
A 00012 00012 00007
A 00015 00015 00009
C 00015 00018 00023
A 00015 00015 00009
F 00023
*B 00022
D 00016 00007 00010
F 00012 00076 00016
A 00011 00012 00019
S 00012 00005 00012
G 00013 00030 00011
M 00014 00010 00013
M 00015 00014 00006
C 00017 00015 00023
G 00013 00029 00011
M 00015 00010 00013
A 00012 00012 00007
*B 00023
M 00015 00015 00025
H 00001 00004 00015
H 00002 00004 00012
F 90011
*R 00076
G 00080 00076 00078
R 00081 00082
R 00084 00005
*B 00085
D 00081 00081 00083
C 00007 00081 00086
A 00084 00084 00081
C 00084 00090 00089
G 00087 00091 00084
C 00080 00087 00085

K= 00249

S 00084 00084 00081
C 00087 00080 00085
A 00084 00084 00081
*B 00086
H 00076 00079 00084
F 00077
V 00028 +10000000+08
V 00082 +64000000+02
V 00083 +20000000+C1
*B 00089
S 00084 00084 00081
F 00085
V 00090 +37000000+02
V 00091 +10000000+01
V 00092 +10000000+02
V 00093 +10000000+03
V 00094 +10000000+04
V 00095 +10000000+05
V 00096 +10000000+06
V 00097 +10000000+07
V 00098 +10000000+08
V 00099 +10000000+09
V 00100 +10000000+10
V 00101 +10000000+11
V 00102 +10000000+12
V 00103 +10000000+13
V 00104 +10000000+14
V 00105 +10000000+15
V 00106 +10000000+16
V 00107 +10000000+17
V 00108 +10000000+18
V 00109 +10000000+19
V 00110 +10000000+20
V 00111 +10000000+21
V 00112 +10000000+22
V 00113 +10000000+23
V 00114 +10000000+24
V 00115 +10000000+25
V 00116 +10000000+26
V 00117 +10000000+27
V 00118 +10000000+28
V 00119 +10000000+29

K= 00249

V 00120 +10000000+30
V 00121 +10000000+31
V 00122 +10000000+32
V 00123 +10000000+33
V 00124 +10000000+34
V 00125 +10000000+35
V 00126 +10000000+36
V 00127 +10000000+37
V 00128 +10000000+38

0563 CARDS

Mystic Tracer

Put a blank tape on B-5 and an input tape on B-4 from the 1401 Bumper program.

OPERATORS REPORT

OPERATOR _____

LOCATION COUNTER

AT STOP SELECT OTHER

ACTION TAKEN

TIME ON
 TIME OFF

HALTS	ACTION TO BE TAKEN
any	TRA 23,000

SUPPLEMENTARY OPERATING NOTES

PRINT OUTPUT TAPES

LOGICAL	P.C.	FILES	COPIES
LOGICAL	23 P.C.	FILES 1	COPIES 1
LOGICAL	123 P.C.	FILES	COPIES