

Emanuel Melichar

Economist

Board of Governors of the Federal Reserve System

Washington 25, D. C.

PURPOSE

Minitrace 2 is a trace program for IBM 1401 computers with more than 4,000 digits of core storage. It is designed to furnish the information normally provided by a full trace program while using a minimum of core space and requiring almost no set-up work. A trace program is used in testing and debugging other programs, its output consisting of information about the execution of the program being traced. Minitrace 2 monitors each instruction of the program being traced, and except for fully-chained instructions prints one line for each such instruction after it is executed. The contents of this line are as follows:

<u>Print positions</u>	<u>Information printed</u>
1- 3	Address of the instruction being traced.
4	The letter "C" if one or more fully-chained instructions follow the instruction being traced.
6	OP-code of the instruction being traced.
8-10	A-operand of the instruction being traced.
12-14	B-operand of the instruction being traced.
16	d-character of the instruction being traced.
18-20	Contents of Index 1.
22-24	Contents of Index 2.
26-28	Contents of Index 3.
30-43	Up to 14 digits of the contents, after execution, of the field addressed by the A-operand of the instruction being traced. An asterisk indicates the length of the field.
45-58	Up to 14 digits of the contents, after execution, of the field addressed by the B-operand of the instruction being traced. An asterisk indicates the length of the field.
59	Always a blank.
60	Always a record-mark.

MACHINE REQUIREMENTS

Minitrace 2 uses 981 digits of core memory and may be assembled anywhere in core except the print area. For example, it may be assembled with origin at 7019 to use positions 7019-7999.

Other machine requirements are:

- More than 4,000 digits of core memory
- Advanced programming feature
- Index registers
- Store address register instructions
- Move record instruction
- 1403 Printer.

PROCEDURE

Minitrace 2 has been designed to avoid almost all "setting-up" of the program deck to be traced. In most cases, it is merely necessary to remove the "END" card from the deck to be traced, place Minitrace 2 behind the remainder of the deck, place any data cards used behind Minitrace 2, and load and run the combined deck, following exactly the procedures specified for the program being traced.

EXECUTION TIME

With the print storage feature, the trace runs at maximum printer speed with double-spacing, i.e., about 500 instructions will be traced per minute. Input and output operations executed by the program being traced will use their normal additional time.

SOURCE LANGUAGE

SPS

LIMITATIONS

Minitrace 2 will trace all generally known 1401 instructions. There are several minor limitations and requirements, fully described in the Write-Up, that are imposed in order to reduce the core space used by Minitrace 2.

CHECK-OUT STATUS

Minitrace 2 has been used to trace a variety of programs on systems that include tape, Ramac, and 1407 console equipment. The nature of the program is such, however, that it may still contain bugs or may be unable to handle some instruction or sequence of instructions that was not anticipated by the author. The author therefore requests that each user, as a service to other users, inform him of all difficulties encountered in order that the program may be modified or that a description of the limitation may be added to the Write-Up.

OPERATING PROCEDURES

A. Standard trace

1. Remove the last card (END card) from the assembled program to be traced.
2. Place the Minitrace 2 deck behind the program deck to be traced.
3. Place data cards, if any, behind the Minitrace 2 deck.
4. Load and run the combined deck.

Follow the procedures specified for the program being traced.
(Check for switches, carriage control tape, etc.)

Precaution--If not altered, Minitrace 2 will expect to find the first instruction of the program being traced in core location 333. To begin tracing at a different address, that address should be inserted as the contents of FX, the constant that occupies the first 3 digits of Minitrace 2. For example, if Minitrace 2 is assembled with origin at 7019 and a program is to be traced starting at R28, then R28 should be inserted into 7019-7021. See B.2 below for instructions for altering this constant in the Minitrace deck.

B. Trace of particular part of program

1. Remove "End" card from program to be traced.
2. Replace 1st card of Minitrace 2 with a card which is identical except that the address at which tracing is to begin is punched into columns 24-26 of an uncondensed SPS Minitrace deck or into columns 1-3 of a condensed SPS or Autocoder Minitrace deck.
3. Put the Minitrace 2 deck behind the program to be traced.
4. Replace the last card of Minitrace 2 with the "End" card from the program to be traced.
5. Place data cards, if any, behind the combined decks.
6. Set address stop to the address at which tracing is to begin.
7. Load and run the program to the address stop. The Start button must be pressed twice at address stops during loading.
8. Set the I-address register to 7022, the address of the first instruction of Minitrace 2.
9. Press Start to begin tracing.

To stop tracing before the execution of a given instruction, set address stop to the address of the instruction which follows that instruction. A portion or the remainder of the program being traced may then be properly executed by restarting at the address of the given instruction. Tracing may be resumed later in the program by the following procedure:

1. Set address stop to the address of the instruction at which tracing is to be resumed.
2. Press Start and run the program to the address stop.

3. Put the address of the instruction at which tracing is to be resumed into core locations 7019-7021.
4. Reset the I-address register to 7022.
5. Press Start to resume tracing.

REQUIREMENTS, LIMITATIONS, AND FURTHER EXPLANATION

A. Fully-chained instructions

Minitrace 2 can accommodate up to 27 full-chain instructions in a row in the circumstances which place the most severe limitation on the number that can be handled. In other words, if the program being traced does not contain a string of more than 27 consecutive fully-chained instructions, it can be traced and the next paragraph can be ignored.

If the chain follows an instruction which is less than 8 digits long, the number of consecutive fully-chained instructions that can be traced is increased by one for each digit by which the instruction preceding the chain is shorter than 8. If the chain is not followed by a 4-digit instruction whose op-code is either M, L, Q, or H, or by a 4-digit constant whose first character is M, L, Q, or H, the number of consecutive fully-chained instructions that can be traced is increased by 4.

B. Incorrect indication of presence of full-chain

If, in the program being traced, it happens that one-digit constants that contain characters that are op-codes that can be chained follow an unconditional branch instruction in core storage layout, Minitrace 2 will be fooled into thinking that a chain will be executed, and will print "C" after the address of the branch instruction. This incorrect notation does not otherwise affect the trace, and is mentioned here only because it might be confusing in the rare occasions when it is encountered.

C. Explanation of use of asterisks to indicate length of fields

When the contents of the fields addressed by the A-operand and B-operand are moved prior to being printed, the move is stopped either by the word-mark of the field addressed or when the 14th digit of the field is moved. The asterisk is then printed in the position immediately to the left of the last digit moved. The asterisk thus indicates the length of the field addressed, provided it is less than 14 digits long.

D. Minitrace 2 sets a word mark in 001

A word mark is set in core location 001 and remains set during execution of the program being traced. The latter must therefore be able to function under this condition.

E. Stacker and printer skip instructions

A Skip After Print instruction is executed directly after the trace of that instruction is printed rather than after the next Print instruction in the program being traced. An Immediate Skip instruction is executed directly before the trace of that instruction is printed.

A Select Stacker instruction given after a Read instruction will not be effective because it will not be executed within the necessary time limit. All cards read should be expected to fall into the normal read pocket.

F. A- and B-operand of 000

Minitrace 2 does not print the contents of location 000 if this position is addressed by the program being traced.

The instruction with this operand (e.g., N 000 or H 089 000) will be correctly executed.

G. Word marks must follow all instructions

It is recommended that programs that may be traced be written with word marks in the location following each instruction, thus extending the general requirement to the three instructions that do not ordinarily require such a word mark (the 4-digit unconditional Branch, the 7-digit Set Word Mark, and the 7-digit Clear Storage and Branch).

However, Minitrace 2 will usually be able to trace the above instructions if a word mark occurs in core within 32 digits after the last digit of the instruction (within 35 digits of the 4-digit unconditional Branch).

The author's experience has shown that this requirement must especially be kept in mind when writing the last instruction of the program (the instruction preceding the END card) and when patching assembled decks (also remember not to put a patch into locations used by Minitrace 2).

H. Partial logic of Minitrace 2

The following statement of the principal logic employed by Minitrace 2 may be useful in determining whether programs which make unusual use of particular instructions can be traced:

1. The contents of the B-address register after execution of an instruction being traced are stored and returned to the register before execution of the next instruction if the latter is a 4-digit Move, Load, or Store B-address Register instruction. The contents of the A-address register are similarly handled if the next instruction to be traced is a 4-digit Store A-address Register instruction. These are the only cases in which the contents of the registers are stored for use by the next instruction. When a branch occurs, the address of the next sequential instruction following the Branch instruction is introduced into the B-address register prior to execution of the next instruction to be traced.
2. Minitrace 2 recognizes the following 1-digit instructions as fully-chained instructions and causes them to be executed without tracing at the same time that the preceding unchained instruction is executed and traced:

C	□
X	!
W	?
%	L
Q	M
H	/
Z	#
@	E
P	V
D	B
Y	S
,	A

3. Minitrace 2 recognizes that branches may occur to the A-address of instructions with the following op-codes:

B	3
V	5
W	6
.	7
1	K
4	F
2	/ (7-digit instruction only).

Sample Output of Minitrace 2

Trace of Richmond Program 064
Inquiry into account of Transit Department
on Ramac, using 1407 Console

	333	,	087	092	*	*	‡
	340	,	024	040	*	*	‡
	347	,	-01	-04	*	*	‡
12	354	,	-15		*		‡
11	358	B	530	Q	*M		‡
10	363	B	347		*,		‡
9							
8	347	,	-01	-04	*	*	‡
7							
6	354	,	-15		*		‡
5							
4	358	B	530	Q	*M		‡
3							
2	363	B	347		*,		‡
	347	,	-01	-04	*	*	‡
	354	,	-15		*		‡
	358	B	530	Q	*M		‡
	363	B	347		*,		‡
	347	,	-01	-04	*	*	‡
	354	,	-15		*		‡
	358	B	530	Q	*M		‡
	363	B	347		*,		‡
	347	,	-01	-04	*	*	‡
	354	,	-15		*		‡
	358	B	530	Q	*M		‡
	363	B	347		*,		‡
	347	,	-01	-04	*	*	‡
	354	,	-15		*		‡
	358	B	530	Q	*M		‡
	363	B	347		*,		‡
	347	,	-01	-04	*	*	‡
	354	,	-15		*		‡

358	B	530 Q		*M		‡
530	M	XTO S77 R				*2 ‡
538	C	S79 Y/3		*218		*218 ‡
545	B	701 /		*A		‡
550	M	UW1 298		*880		*0008880 ‡
557	B	501		*H		‡
501	H	500		*B561		‡
505	B	385		*NB		‡
509	B	371		*M		‡
371	M	XFO Z92 R				*0 ‡
379	B	406 N		*B		‡
384	N	B48 3		*B		‡
389	N					‡
390	B	434		*M		‡
434	M	XE2 IZ92 R				*0 ‡
442	B	478		*B		‡
478	B	406 Y		*B		‡
483	M	529 528		*1		*1 ‡
490	,	385 390		*B		*B ‡
497	B	561		*C		‡
561	C	S79 -03		*218		*218 ‡
568	B	696 /		*N		‡
573	B	738 B		*M		‡
738	M	S79 213		*218*		218 ‡
745	M	VK5 237		*IT		*IT ‡
752	2	218 TRANSIT				‡
753	/	299		*		‡
757	F	K				‡
759	M	S92 222		*TOTAL DEBITS*		TOTAL DEBITS ‡
766	L	T19 241		*		.0 * , , .0 ‡
773	E	-14 241		*08741587913*		.87,415,879.13 ‡

TOTAL DEBITS 87,415,879.13

780 2 #

781 / 299 *

785 M T05 223 *TOTAL CREDITS* TOTAL CREDITS #

792 L T19 241 * , , .0 # ; , .0 #

799 E -25 241 *02231850889* 22,318,508.89 #

TOTAL CREDITS 22,318,508.89

806 2 #

807 / 299 *

811 F L #

813 H 089 000 #000 #

820 H 094 000 000 #000 #

827 M T34 224 000 000 *DEBITS* DEBITS #

834 M T41 241 000 000 *CREDITS* CREDITS #

841 2 DEBITS 000 000 CREDITS #

842 / 299 000 000 * #

846 F J 000 000 #

848 M -14 T52 000 000 *08741587913 *08741587913 #

855 M -25 T63 000 000 *02231850889 *02231850889 #

862 B 951 -T5 000 000 *L*08890000002750 #

870 , -56 000 000 *0 #

874 V #73 -T5 2 000 000 *L *0000002750 #

#73 L T19 224 000 000 * , , .0 # ; , .0 #

#80 A -T5 T76 000 000 *0000002750 *0000002750 #

#87 E -T5 224 000 000 *0000002750* 27.50 #

#94 B 903 000 000 *2 #

903 2 27.50 000 000 #

904 / 299 000 000 * #

908 # -56 000 000 *02231850889 #

912	B #98 -T6 #	000 000			*□*88900000027500 ‡
920	B /27 -T6 a	000 000			*C*88900000027500 ‡
928	A T65 089	000 000			*10 *010 ‡
935	C 089 S40	010 000			*010 *00E ‡
942	B IS27 S	010 000			*Y ‡
947	B #862	010 000			*B ‡
862	B 951 -T5	010 000			*L*2750000063212M ‡
870	, -S6	010 000			*0 ‡
874	N #73 -T5 2	010 000			*L *000063212M ‡
882	L J19 241	010 000	*	, , .0 *	, , .0 ‡
889	A -T5 J87	010 000			*000063212M *0000063212M ‡
896	E -T5 241	010 000			*000063212M* 6,321.24 ‡
					6,321.24
903	2	010 000			‡
904	/ 299	010 000	*		‡
908	□ -S6	010 000			*88900000027500 ‡
912	B #98 -T6 #	010 000			*□*750000063212M0 ‡

12
11
10
9
8
7
6
5

PG	LN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2	
1	030	3	FX	DCW	*			333 7021				
1	040	7	E2	MCW	TA	ε058	TA	ε057	7022	M H2X H2W		
1	050	1		MCW					7029	M		
1	060	1		MCW					7030	M		
1	070	1		MCW					7031	M		
1	080	1		MCW					7032	M		
1	090	1		MCW					7033	M		
1	100	1		MCW					7034	M		
1	110	1		MCW					7035	M		
1	120	1		MCW					7036	M		
1	130	1		MCW					7037	M		
1	140	1		MCW					7038	M		
1	150	1		MCW					7039	M		
1	160	1		MCW					7040	M		
1	170	7		LCA	TA	ε058	ENDEX		7041	L H2X G4X		
1	180	1		LCA					7048	L		
1	190	7		LCA	TA	ε013	A	ε013	7049	L G8S G1Y		
1	200	4		SW	0001				7056	, 001		
1	210	4		CW	ENDEX	-014			7060	□ G3T		
1	220	7		MCW	FX		TA	ε002	7064	M ε2/ G7/		
1	230	7		MCW	0089		TA	ε019	7071	M 089 G8Y		
1	240	7		MCW	0094		TA	ε023	7078	M 094 G9S		
1	250	7		MCW	0099		TA	ε027	7085	M 099 G9W		
1	260	7		MCW	B	ε001		0089	7092	M G0X 089		
1	270	7		MCW	FX			0094	7099	M ε2/ 094		
1	280	7	E10	SBR	0094			0001	2	7106	H 094 0-1	
1	290	8		BWZ	E15			0000	2	1	7113	V A3S 0-0 1
1	300	7		SBR	0089			0001	1	7121	H 089 0#1	
1	310	4		B	E10					7128	B A0W	
1	320	7	E15	MCW	0000	2	B		1	7132	M 0-0 G+W	
1	330	1		MCW						7139	M	
1	340	7		MCW	BLANKS		B		1	7140	M F9X G+W	
1	350	7		MCW	F8X	-001	BFAD			7147	M G1/ G5U	

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2	
1	360	1		MCW				7154	M			
1	370	7		MCW	F8X	TA	8015	7155	M	G1S G8U		
1	380	7		MCW	A	TA	8005	7162	M	G0V G7U		
1	390	7	E22A	MCW	0000	2	TOP	7169	M	0-0 G4Y		
1	400	7		SBR	0094		0001	2	7176	H	094 0-1	
1	410	8		BWZ	TEST		0000	2	1	7183	V	H2Z 0-0 1
1	420	7	WW	MA	I9I		0094		7191	A	I9Z 094	
1	430	7	ZZ	SBR	0094		0004	2	7198	H	094 0-4	
1	440	8		BWZ	MOD2		0000	2	1	7205	V	B2U 0-0 1
1	450	7	E26AA	MA	I9F		0094		7213	A	I9W 094	
1	460	4		B	E26				7220	B	B7Y	
1	470	8	MOD2	B	E24		TOP		M	7224	B	B6# G4Y M
1	480	8		B	E24		TOP		L	7232	B	B6# G4Y L
1	490	8		B	E24		TOP		H	7240	B	B6# G4Y H
1	500	8		B	E22A45		TOP		Q	7248	B	I1W G4Y Q
1	510	4		B	E26AA					7256	B	B1T
1	520	7	E24	LCA	HXXX 8003		C	1	7260	L	G6S G#Z	
1	530	7	E26AB	SBR	0089		0004	1	7267	H	089 0#4	
1	540	4		B	E26AA					7274	B	B1T
1	550	7	E26	LCA	BXXX 8003		C	1	7278	L	G6W G#Z	
1	560	7		MCW	0094		FX			7285	M	094 82/
1	570	7		MCW	TA 8019		0089			7292	M	G8Y 089
1	580	7		MCW	TA 8023		0094			7299	M	G9S 094
1	590	8		B	EXCUTE		AFAD			7306	B	F9Y G5/
1	600	7		SBR	TXY1 8003		TABLE1			7314	H	C2U C6U
1	610	7	TXY1	MCW	TABLE1		LOOK2 8007			7321	M	C6U C3Z
1	620	4		SAR	TXY1 8003					7328	Q	C2U
1	630	8	LOOK2	B	E60		A		F	7332	B	I3V G0V F
1	640	8		B	TEST2		LOOK2 8007		B	7340	B	C6V C3Z B
1	650	4		B	TXY1					7348	B	C2/
1	660	1		DCW	*			B		7352		
1	670	1		DCW	*			V		7353		
1	680	1		DCW	*			W		7354		
1	690	1	HALT	DCW	*			.		7355		
1	700	1		DCW	*			1		7356		
1	710	1		DCW	*			4		7357		

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2
1	720	1		DCW	*			2	7358		
1	730	1		DCW	*			3	7359		
1	740	1		DCW	*			5	7360		
1	750	1		DCW	*			6	7361		
1	760	1		DCW	*			7	7362		
1	770	1		DCW	*			K	7363		
1	780	1	TABLE1	DCW	*			F	7364		
1	790	8	TEST2	B	E59	A	/	7365	B I2X	GOV /	
1	800	4		B	EXCUTE			7373	B F9Y		
1	810	7	E62	MCW	FX	BREG		7377	M &2/	G0U	
1	820	7		MCW	AFAD	NOPX	&003	7384	M G5/	C9U	
1	830	4	NOPX	NOP	0000			7391	N 000		
1	840	4		SBR	FX			7395	H &2/		
1	850	7	E65	MCW	AFAD	TA	&009	7399	M G5/	G7Y	
1	860	8		B	XY	AFAD		7406	B D5W	G5/	
1	870	8		B	XY	AFAD	-002	7414	B D5W	G4Z %	
1	880	7		MCW	AFAD	NOPY	&003	7422	M G5/	D3S	
1	890	4	NOPY	NOP	0000			7429	N 000		
1	900	4		SBR	E66	&003		7433	H D4Y		
1	910	8		B	DONT	E66	&003	7437	B I4W	D4Y 0	
1	920	7	E66	MCW	0000	TA	&042	7445	M 000	H1/	
1	930	4		MCW	AST			7452	M G6Y		
1	940	7	XY	MCW	BFAD	TA	&013	7456	M G5U	G8S	
1	950	8		B	COMP	BFAD		7463	B E0V	G5U	
1	960	7		MCW	BFAD	NOPZ	&003	7471	M G5U	D8/	
1	970	4	NOPZ	NOP	0000			7478	N 000		
1	980	4		SBR	E67	&003		7482	H D9X		
1	990	8		B	DONT2	E67	&003	7486	B I7#	D9X 0	
2	000	7	E67	MCW	0000	TA	&057	7494	M 000	H2W	
2	010	4		MCW	AST			7501	M G6Y		
2	020	7	COMP	MCW	0260	STORE2		7505	M 260	G6X	
2	030	7		MCW	RM	0260		7512	M F9W	260	
2	040	7		MCW	0089	AFAD		7519	M 089	G5/	
2	050	7		SBR	0089	0201		7526	H 089	201	
2	060	7	CHA	MCM	0000	1	WR -201	7533	P 0#0	DTW	
2	070	4		SAR	0089			7540	Q 089		

LINE	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2
080	8		B	DONE	0088	6	7544	B E5W 088 6		
090	4		B	CHA			7552	B E3T		
100	7	DONE	SBR	0089	0201		7556	H 089 201		
110	7	CHAR	MCM	TA -201 1	0000	1	7563	P EWY 0#0		
120	4		SBR	0089			7570	H 089		
130	8		B	DONE3	0088	6	7574	B E8W 088 6		
140	4		B	CHAR			7582	B E6T		
150	2	DONE3	CC			S	7586	F S		
160	1		W				7588	2		
170	7		SBR	0089	0201		7589	H 089 201		
180	7	CHARL	MCM	WR -201 1	0000	1	7596	P DTW 0#0		
190	4		SBR	0089			7603	H 089		
200	8		B	DONE6	0088	6	7607	B F1Z 088 6		
210	4		B	CHARL			7615	B E9W		
220	7	DONE6	MCW	STORE2	0260		7619	M G6X 260		
230	7		MCW	AFAD	0089		7626	M G5/ 089		
240	4		B	E2			7633	B &2S		
250	1	WR	DCW	*			7637			
260	29		DC	*			7666			
270	29		DC	*			7695			
280	1	RM	DCW	*		#	7696			
290	1	BLANKS	DCW	*			7697			
300	1	EXCUTE	DCW	*		N	7698			
310	3	AREG	DC	*		000	7701			
320	3	BREG	DC	*		000	7704			
330	1	A	DCW	*			7705			
340	1	B	DC	*			7706			
350	3	C	DC	*			7709			
360	3	F8X	DC	*			7712			
370	1	D	DC	*			7713			
380	4		DC	*			7717			
390	30	ENDEX	DC	*			7747			
400	1	TOP	DCW	*			7748			
410	3	AFAD	DCW	*			7751			
420	3	BFAD	DCW	*			7754			
430	4	QXXX	SAR	AREG			7755	Q 60/		

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2
2	440	4	HXXX	SBR	BREG			7759	H GOU		
2	450	4	BXXX	B	E65			7763	B C9Z		
2	460	1	STORE2	DCW	*			7767			
2	470	1	AST	DCW	*		*	7768			
2	480	1	TA	DCW	*			7769			
2	490	14		DC	*			7783			
2	500	2		DCW	*			7785			
2	510	4		DCW	*			7789			
2	520	4		DCW	*			7793			
2	530	4		DCW	*			7797			
2	540	15		DCW	*			7812			
2	550	15		DCW	*			7827			
2	560	1		DCW	*		‡	7828			
2	570	7	TEST	SBR	TXY &003	TABLE		7829	H H3Z H9‡		
2	580	7	TXY	MCW	TABLE	LOOK1 &007		7836	M H9‡ H5U		
2	590	4		SAR	TXY &003			7843	Q H3Z		
2	600	8	LOOK1	B	E22A34	TDP	A	7847	B H9/ G4Y A		
2	610	8		B	WW	LOOK1 &007	C	7855	B A9/ H5U C		
2	620	4		B	TXY			7863	B H3W		
2	630	1	CH	DCW	*		C	7867			
2	640	1		DCW	*		X	7868			
2	650	1		DCW	*		W	7869			
2	660	1		DCW	*		%	7870			
2	670	1		DCW	*		Q	7871			
2	680	1		DCW	*		H	7872			
2	690	1		DCW	*		Z	7873			
2	700	1		DCW	*		@	7874			
2	710	1		DCW	*		P	7875			
2	720	1		DCW	*		D	7876			
2	730	1		DCW	*		Y	7877			
2	740	1		DCW	*		,	7878			
2	750	1		DCW	*		□	7879			
2	760	1		DCW	*		-	7880			
2	770	1		DCW	*		&	7881			
2	780	1		DCW	*		L	7882			
2	790	1		DCW	*		M	7883			

PG	LIN	CT	LABEL	OP	A OPERAND	B OPERAND	D	LOC	INSTRUCTION	COMMENTS	MITR2
2	800	1		DCW	*			/ 7884			
2	810	1		DCW	*			# 7885			
2	820	1		DCW	*			E 7886			
2	830	1		DCW	*			V 7887			
2	840	1		DCW	*			B 7888			
2	850	1		DCW	*			S 7889			
2	860	1	TABLE	DCW	*			A 7890			
2	870	7	E22A34	MCW	CH	TA	&003	7891	M H6X	G7S	
2	880	7		LCA	TOP	B	1	7898	L G4Y	G+W	
2	890	7		SBR	0089	0001	1	7905	H 089	0+1	
2	900	4		B	E22A			7912	B A6Z		
2	910	7	E22A45	LCA	QXXX	&003	C	7916	L G5Y	G+Z	
2	920	4		B	E26AB			7923	B B6X		
2	930	8	E59	B	EXCUTE	BFAD		7927	B F9Y	G5U	
2	940	7	E60	SBR	F8X	-004	E62	7935	H G0Y	C7X	
2	950	4		B	EXCUTE			7942	B F9Y		
2	960	8	DONT	B	DONT1	E66	&002	0	7946	B I5Y	D4X 0
2	970	4		B	E66			7954	B D4V		
2	980	8	DONT1	B	XY	E66	&001	0	7958	B D5W	D4W 0
2	990	4		B	E66			7966	B D4V		
3	000	8	DONT2	B	DONT3	E67	&002	0	7970	B I8S	D9W 0
3	010	4		B	E67			7978	B D9U		
3	020	8	DONT3	B	COMP	E67	&001	0	7982	B E0V	D9V 0
3	030	4		B	E67			7990	B D9U		
3	040	3	I9F	DCW	*			19F 7996			
3	050	3	I9I	DCW	*			19I 7999			
3	060			END	E2				/ &2S	080	

204 CARDS