

**MPF-I
MONITOR
PROGRAM
SOURCE LISTING**

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LOC OBJ CODE M STMT SOURCE STATEMENT

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1 ;*****
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8 ;*
9 ;*****
10 ;
11 ;
12 ;
13 ;
14 ;
15 P8255 EQU 03H ;8255 I control port
16 DIGIT EQU 02H ;8255 I port C
17 SEG7 EQU 01H ;8255 I port B
18 KIN EQU 00H ;8255 I port A
19 PWCODE EQU 0A5H ;Power-up code
20 ZSUM EQU 71H ;This will make the sum of all
21 ;monitor codes to be zero.
22
23 ; The following EQUATES are used for timing. Their values
24 ; depend on the CPU clock frequency. (In this version, the
25 ; crystal frequency is 1.79 MHz.)
26
27 COLDEL EQU 201 ;Column delay time for routine
28 ;SCAN and SCAN1.
29 F1KHZ EQU 65 ;Delay count for 1K Hz square wave,
30 ;used by routin TONE1K.
31 F2KHZ EQU 31 ;Delay count for 2K Hz square wave,
32 ;used by routine TONE2K.
33 MPERIOD EQU 42 ;1K Hz and 2K Hz threshold, used by
34 ;tape input routine PERIOD.
35
36 ; The following EQUATES are for tape modulation.
37 ; If the quality of tape recorder is good, the user may
38 ; change '4 4 2 8' to '2 2 1 4'. This will double
39 ; the tape data rate.
40 ; If the quality of tape recorder is poor, the user may
41 ; change '4 4 2 8' to '6 6 3 12'. This will improve
42 ; error performance but slow down the data rate.
43 ; Although the data format is changed, the tape is still
44 ; compatible in each case, because only the ratio is
45 ; detected in the Tape-read.
46
47 ONE_1K EQU 4
48 ONE_2K EQU 4
49 ZERO_1K EQU 2
50 ZERO_2K EQU 8
51
52 ;*****
53 ; I/O port assignment: (8255 I)
54
55 ; port A (address 00H):
56 ; bit 7 -- tape input
57 ; bit 6 -- 'USER KEY' on keyboard, active low
58 ; bit 5-0 row of keyboard matrix input ,active low

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59 ; port B (address 01H): 7 segments of LED, active high
60 ;     bit 7 -- segment d
61 ;     bit 6 -- decimal point
62 ;     bit 5 -- segment c
63 ;     bit 4 -- segment b
64 ;     bit 3 -- segment a
65 ;     bit 2 -- segment f
66 ;     bit 1 -- segment g
67 ;     bit 0 -- segment e
68 ; port C (address 02H):
69 ;     bit 7 -- tape & tone output
70 ;     bit 6 -- BREAK enable. NMI (CPU pin 17) will go to
71 ;         low 5 M1's (machine cycle one) after this
72 ;         bit goes to low. (This bit is connected to
73 ;         the reset input of external counter.)
74 ;     bit 5 -- columns of keyboard and display matrix,
75 ;         active high. Bit 5 is the leftmost column.
76
77 ;*****
78 ; -- reset --
79 ; There are two cases that will generate a RESET signal:
80 ;     (i) power-up
81 ;     (ii) 'RS' key pressed
82 ; In both cases, the following actions will be taken:
83 ;     a) disable interrupt, set interrupt mode to 0
84 ;     set I register to 00 and start execution
85 ;     at address 0000 (by Z80 CPU itself).
86 ;     b) initial user's PC to the lowest RAM address;
87 ;     c) set user's SP to 1F9FH;
88 ;     d) set user's I register to 00 and disable user's
89 ;     interrupt flip-flop;
90 ; In addition, subroutine INI will be called on power-up
91 ; reset, which has the following effects:
92 ;     e) disable BREAK POINT;
93 ;     f) set the contents of location 1FEEH 1FEFH to 66 and
94 ;     and 00 respectively. This will make instruction RST
95 ;     38H (opcode FF) have the same effect as BREAK.
96 ; Memory location POWERUP is used to distinguish power-up
97 ; from RS-key. (POWERUP) contains a random data when
98 ; power-up and contains PWCOD (0A5H) thereafter.
99
0000 0600      100      LD      B,0
0002 10FE      101      DJNZ   $      ;Power-up delay
102
103 ; Initial 8255 to mode 0 with port A input, port B and C
104 ; output. The control word is 90H.
105
0004 3E90      106      LD      A,10010000B
0006 D303      107      OUT    (P8255),A
108
109 ; When the control word is sent out to 8255, all output
110 ; ports are cleared to 0. It is necessary to disable
111 ; BREAK and deactivate all I/O by sending 0COH to
112 ; port C.
113
0008 3EC0      114      LD      A,0COH
000A D302      115      OUT    (DIGIT),A
000C 31AF1F    116      LD      SP,SYSSTK      ;initial system stack

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117
118 ; If the content of location POWERUP is not equal to
119 ; PWCODE, call subroutine INI. Continue otherwise.
120
000F 3AE51F 121 LD A,(POWERUP)
0012 FE45 122 CP PWCODE
0014 C4C103 123 CALL NZ,INI
124
125 ; Determine the lowest RAM address by checking whether
126 ; address 1000H is RAM. If yes, set user's PC to this
127 ; value. Otherwise, set it to 1800H.
128
0017 210010 129 LD HL,1000H
001A CDF605 130 CALL RAMCHK
001D 2802 131 JR Z,PREPC
001F 2618 132 LD H,18H
0021 22DC1F 133 PREPC LD (USERPC),HL
0024 2600 134 LD H,0
135
136 ; Address 28H and 30H are reserved for BREAK (RST 28H)
137 ; and software BREAK (RST 30H). Skip these area, monitor
138 ; program resumes at RESET1.
139
0026 180A 140 JR RESET1
141 ;
142 ;*****
0028 143 RST28 ORG 28H
144 ; Address 28H is the entry point of BREAK trap.
145 ; If a location is set as a BREAK point, the monitor
146 ; will change the content of this location to C7 (RST 28H)
147 ; before transferring control to user's program.
148 ; In execution of user's program, a trap will occur if
149 ; user's PC passes this location. The monitor then takes
150 ; over control and the content of BREAK address
151 ; will be restored. Monitor takes care of everything
152 ; and makes the whole mechanism transparent to the user.
153 ; The return address pushed onto stack is the PC after
154 ; executing RST 28H. The original break address should
155 ; be one less than that. The following 3 instructions
156 ; decrease the content of (SP) by one without changing
157 ; HL.
158
0028 E3 159 EX (SP),HL
0029 2B 160 DEC HL
002A E3 161 EX (SP),HL
002B 22E81F 162 LD (HLTEMP),HL
002E 180E 163 JR CONT28
164 ;
165 ;*****
0030 166 RST30 ORG 30H
167
168 ; Instruction RST 30H (opcode F7) is usually used as:
169 ; i) Software break;
170 ; ii) Terminator of user's program.
171 ; The effect of this instruction is to save all user's
172 ; registers and return to monitor.
173
0030 1834 174 JR NMI

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LOC	OBJ CODE M	STMT	SOURCE STATEMENT
		175	
		176	*****
		177	; This is a part of reset routine. Address 0028 and
		178	; 0030 are reserved for break point. Reset routine
		179	; skips this area and resumes here.
		180	;
0032	22D21F	181	RESET1 LD (USERIF),HL ;set user's I register and
		182	;interrupt flip flop to 0
0035	181D	183	JR RESET2 ;monitor resumes at RESET2
		184	;
		185	*****
		186	;
		187	; The following byte makes the sum of the monitor
		188	; code in ROM zero. ROMTEST is a self-checking routine.
		189	; This routine requires the sum of ROM to be zero.
		190	;
0037	71	191	DEFB ZSUM
		192	;
		193	*****
0038		194	RST38 ORG 38H
		195	;
		196	; Entry point of RST 38H (opcode FF) or mode 1 interrupt.
		197	; Fetch the address stored in location 1FEE and 1FEF,
		198	; then jump to this address. Initially, 1FEE and 1FEF
		199	; are set to 0066. So RST 38 will have the same effect
		200	; as software break. By changing the content of 1FEE
		201	; and 1FEF, the user can define his or her own service
		202	; routine.
		203	; The next three instructions push the contents of 1FEE
		204	; and 1FEF to stack without changing any registers.
		205	;
0038	E5	206	PUSH HL
0039	2AE1F	207	LD HL,(IM1AD)
003C	E3	208	EX (SP),HL
		209	;
		210	; The top of the stack is now the address of user
		211	; defined service routine. Pop out this address then
		212	; branch to it.
		213	;
003D	C9	214	RET
		215	;
		216	*****
		217	CONT28:
		218	; This is a part of break service routine. It continues
		219	; the program at RST28.
		220	;
003E	32E71F	221	LD (ATEMP),A
		222	;
		223	; The monitor has changed the content of user's
		224	; program at break address. The next 3 instructions
		225	; restored the destroyed content. BRAD contains the
		226	; break address, BRDA contains the original data at
		227	; break address.
		228	;
0041	2AE01F	229	LD HL,(BRAD)
0044	3AE21F	230	LD A,(BRDA)
0047	77	231	LD (HL),A
		232	;

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LOC	OBJ CODE M	STMT	SOURCE STATEMENT
		233	; Send break enable signal to hardware counter.
		234	; A nonmaskable interrupt will be issued at the 5th M1's.
		235	
0048	3E80	236	LD A,1000000B
004A	D302	237	OUT (DIGIT),A
004C	3AE71F	238	LD A,(ATEMP) ; 1st M1
004F	2AE81F	239	LD HL,(HLTEMP) ; 2nd M1
0052	00	240	NOP ; 3rd M1
0053	C9	241	RET ; 4th M1
		242	
		243	; Return to user's program. Execute the instruction
		244	; at break address. After finishing one instruction,
		245	; a nonmaskable interrupt happens and control is
		246	; transferred to the monitor again.
		247	;
		248	RESET2:
0054	219F1F	249	LD HL,USERSTK
0057	22D01F	250	LD (USERSP),HL ;set user's SP
005A	AF	251	XOR A
005B	32E61F	252	LD (TEST),A
		253	
		254	; TEST is a flag for monitor's own use. Illegal key-in
		255	; blanking (bit 7 of TEST) and automatic leading zero
		256	; (bit 0) use this flag. Clear it here.
		257	
005E	DD219F07	258	LD IX,MPF_I ;Initial display pattern.
		259	
		260	; Address 0066 is the address for nonmaskable interrupt.
		261	; Skip this area, monitor resumes at SETSTO
		262	
0062	C3D000	263	JP SETSTO
		264	;
		265	*****
0066		266	NMI ORG 66H
		267	
		268	; Entry point of nonmaskable interrupt. NMI will occur
		269	; when MONI key is pressed or when user's program is
		270	; broken. The service routine which starts here saves all
		271	; user's registers and status. It also check the validity
		272	; of user's SP.
		273	
0066	32E71F	274	LD (ATEMP),A ;save A register
0069	3E90	275	LD A,1001000B
006B	D303	276	OUT (P8255),A ;set 8255 to mode 0.
		277	;Port A input; B,C output.
006D	3ECO	278	LD A,0COH
006F	D302	279	OUT (DIGIT),A ;disable break and LED's
0071	3AE71F	280	LD A,(ATEMP) ;restore A register
0074	22E81F	281	RGSAVE LD (HLTEMP),HL ;save register HL
0077	E1	282	POP HL ;get return address from stack
0078	22DE1F	283	LD (ADSAVE),HL ;Save return address into
		284	;ADSAVE.
007B	22DC1F	285	LD (USERPC),HL ;Set user's PC to return
		286	;address.
007E	2AE81F	287	LD HL,(HLTEMP) ;restore HL register
0081	ED73D01F	288	LD (USERSP),SP ;set user's SP to current SP
0085	31D01F	289	LD SP,USERIY+2 ;save other registers by
0088	FDE5	290	PUSH IY ;continously pushing them

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LOC	OBJ CODE M	STMT	SOURCE STATEMENT
008A	DDE5	291	PUSH IX ;onto stack
008C	D9	292	EXX
008D	E5	293	PUSH HL
008E	D5	294	PUSH DE
008F	C5	295	PUSH BC
0090	D9	296	EXX
0091	08	297	EX AF,AF'
0092	F5	298	PUSH AF
0093	08	299	EX AF,AF'
0094	E5	300	PUSH HL
0095	D5	301	PUSH DE
0096	C5	302	PUSH BC
0097	F5	303	PUSH AF
		304	
		305	; The next two instructions save I register.
		306	; The interrupt flip-flop (IFF2) is copied into
		307	; parity flag (P/V) by instruction LD A,I.
		308	; The interrupt status (enabled or disabled)
		309	; can be determined by testing parity flag.
		310	
0098	ED57	311	LD A,I
009A	32D31F	312	LD (USERIF+1),A
		313	
		314	; The next four instructions save IFF2 into
		315	; user's IFF.
		316	
009D	3E00	317	LD A,0
009F	E2A400	318	JP PO,SETIF ;PO -- P/V = 0
00A2	3E01	319	LD A,1
00A4	32D21F	320	SETIF LD (USERIF),A
		321	;
00A7	31AF1F	322	LD SP,SYSSTK ;set SP to system stack
		323	
		324	; The next 8 instructions check user's SP.
		325	; If the user's SP points to a location not
		326	; in RAM, display ERR-SP.
		327	
00AA	2AD01F	328	LD HL,(USERSP)
00AD	DD21B507	329	LD IX,ERR_SP
00B1	2B	330	DEC HL
00B2	CDF605	331	CALL RAMCHK
00B5	2019	332	JR NZ,SETSTO
00B7	2B	333	DEC HL
00B8	CDF605	334	CALL RAMCHK
00BB	2013	335	JR NZ,SETSTO
		336	
		337	; If the user's stack and system stack are
		338	; overlaid, display SYS-SP. This checking
		339	; is done by the following instructions.
		340	
00BD	DD21AF07	341	LD IX,SYS_SP
00C1	00	342	NOP
00C2	00	343	NOP
		344	
00C3	1162E0	345	LD DE,-USERSTK+1
00C6	19	346	ADD HL,DE
00C7	3807	347	JR C,SETSTO
00C9	DD21B61F	348	LD IX,DISPBF

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LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
00CD	37		349	SCF	;set carry flag to indicate
			350		;the user's SP is legal.
00CE	1804		351	JR	BRRSTO
			352		;
			353	SETSTO:	
			354		; STATE is a memory location contains the monitor status.
			355		; It will be described in detail later. STATE 0 stands
			356		; for fixed display pattern. The initial pattern 'uPF--1'
			357		; or message 'SYS-SP'... belong to this category. The next
			358		; two instruction set STATE to zero.
			359		
00D0	AF		360	XOR	A ;set A to 0, also clear Carry flag
00D1	32E41F		361	LD	(STATE),A
00D4	3AE21F		362	BRRSTO	LD A,(BRDA) ;restore the data at
			363		;break address
00D7	2AE01F		364	LD	HL,(BRAD)
00DA	77		365	LD	(HL),A
			366		
			367		; If the user's SP is legal (carry set),
			368		; display user's PC and the content at PC.
			369		; Otherwise, display fixed message (ERR-SP
			370		; or SYS-SP or uPF--1)
00DB	DC0B04		371	CALL	C,MEMDP2
			372		;
			373		;
			374		*****
			375		; Scan the display and keyboard. When a key is
			376		; detected, take proper action according to the
			377		; key pressed.
			378		
			379	MAIN:	
00DE	31AF1F		380	LD	SP,SYSSTK ;Initial system stack.
00E1	CDFE05		381	CALL	SCAN ;Scan display and input keys.
			382		;Routine SCAN will not return until
			383		;any key is pressed.
00E4	CDCB06		384	CALL	BEEP ;After a key is detected, there
			385		;will be accompanied with a beep
			386		;sound.
00E7	18F5		387	JR	MAIN ;Back to MAIN, get more keys and
			388		;execute them.
			389		;
			390		;
			391		*****
			392	KEYEKEC:	
			393		
			394		; Input key dispatch routine.
			395		; This routine uses the key code returned by subroutine
			396		; SCAN, which is one byte stored in A register. The
			397		; range of key code is from 00 to 1FH.
			398		
			399		; (i) key code = 00 ç OFH :
			400		; These are hexadecimal keys. Branch to routine KHEX.
			401		
00E9	FE10		402	CP	10H
00EB	3824		403	JR	C,KHEX
			404		
			405		; If the key entered is not hexadecimal, it must be a
			406		; function or subfunction key. This means the previous

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LOC   OBJ CODE M STMT SOURCE STATEMENT

407 ; numeric entry has terminated. Bit 0 of TEST flag
408 ; must be set at the beginning of a new numeric entry.
409 ; This is done by the next two instructions. (If bit 0
410 ; of TEST is set, the data buffer will be automatically
411 ; cleared when a hexadecimal key is entered.)
412
00ED 21E61F 413 LD HL,TEST
00FO CBC6 414 SET 0,(HL)
415
416 ; (ii) key code = 10H  $\phi$  17H :
417 ; (+, -, GO, STEP, DATA, SBR, INS, DEL)
418 ; There is no state corresponding to these keys.
419 ; The response of them depends on the current
420 ; state and minor-state. (E.g., the response of '+'
421 ; key depends on the current function. It is illegal
422 ; when the display is 'uPF--1', but is legal when the
423 ; display is of 'address-data' form.) In this
424 ; documentation, they are named 'sub-function key'.
425 ; They are all branched by table KSUBFUN and routin
426 ; BRANCH.
427
00F2 D610 428 SUB 10H
00F4 FE08 429 CP 8
00F6 213707 430 LD HL,KSUBFUN
00F9 DAB003 431 JP C,BRANCH
432
433 ;(iii) key code = 18H  $\phi$  1FH
434 ; (PC, Addr, CBr, Reg, Move, Rela, WRtape, RDtape)
435 ; These keys are named 'function key'. They are
436 ; acceptable at any time. When they are hit, the
437 ; monitor will unconditionally enter a new state.
438 ; STMINOR contains the minor-state, which is required
439 ; to dispatch some sub-function keys (e.g. +, - ).
440
00FC DD21B61F 441 LD IX,DISPBF
0100 D608 442 SUB 8
0102 21E41F 443 LD HL,STATE
0105 77 444 LD (HL),A ;set STATE to key-code minus 18H
445 ;The STATE is update here. It will
446 ;be modified later by local service
447 ;routines if the function-key is PC,
448 ;Addr or CBr. For other function-
449 ;keys, STATE will not be modified
450 ;later.
0106 21E31F 451 LD HL,STMINOR
0109 3600 452 LD (HL),0 ;set STMINOR to 0
010B 214107 453 LD HL,KFUN ;KFUN is the base of branch table
454 ;the offset is stored in A
010E C3B003 455 JP BRANCH
456
457 ;
458 ;*****
459 ;STATE:
460 ; 0=FIX ;Display fixed pattern, e.g. 'uPF--1'.
461 ; 1=AD ;The hex key entered is interpreted as
462 ;memory address.
463 ; 2=DA ;The hex key entered is interpreted as
464 ;memory data.

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465 ; 3=RGFIX ;Display fixed pattern: 'Reg- ' and
466 ; ;expect register name to be entered.
467 ; 4=MV ;Expect parameters for 'Move' function.
468 ; 5=RL ;Expect parameters for 'Rela' function.
469 ; 6=WT ;Expect parameters for 'WRtape' func.
470 ; 7=RT ;Expect parameters for 'RDtape' func.
471 ; 8=RGAD ;Hex-key entered will be interpreted as
472 ; ;address name for registers.
473 ; 9=RGDA ;Hex-key entered will be interpreted as
474 ; ;data for registers.
475 ;
476 ; Subroutine name conventions:
477 ; (i) K???? -- K stands for key, ??? is the key name,
478 ; ;e.g. KINS corresponds to key 'INS'. Each
479 ; ;time a key ??? is entered, the routine
480 ; ;with name K???? will be executed. All of
481 ; ;them are branched by table KFUN or KSUBFUN.
482 ; (ii) H???? -- H stands for hexadecimal, ??? is the
483 ; ;current STATE. For example, routine
484 ; ;HDA will be executed if the entered
485 ; ;key is hexadecimal and STATE is DA now.
486 ; ;These routines are branched by table
487 ; ;HTAB.
488 ; (iii) I???? -- I stands for increment (+ key), ??? is
489 ; ;the current STATE. E.g. IMV will be
490 ; ;executed when STATE is MV and '+' key
491 ; ;is entered. These routines are branched
492 ; ;by table ITAB
493 ; (iv) D???? -- D stands for decrement (- key), ??? is
494 ; ;the current STATE. These routines are
495 ; ;branched using table DTAB.
496 ; (v) G???? -- G stands for 'GO' key, ??? is the current
497 ; ;STATE. These routines are branched using
498 ; ;table GTAB.
499 ;
500 ;*****
501 ;
502 ; Hexadecimal, '+', '-' and 'GO' key may be entered after
503 ; ;different function keys. The monitor uses branch tables
504 ; ;and STATE to determine the current function and branch
505 ; ;to the proper entry point.
506 ;
507 KHEX:
508 ;Executed when hexadecimal keys are pressed.
509 ;Use HTAB and STATE for further branch.
510 ;
0111 4F 511 LD C,A ;save A register in C
512 ; ;which is the hex key-code.
0112 214B07 513 LD HL,HTAB
0115 3AE41F 514 BR1 LD A,(STATE)
0118 C3B003 515 JP BRANCH
516 ;
517 ;
518 KINC:
519 ;Branched by KSUBFUN table.
520 ;Executed when '+' key is pressed.
521 ;Use ITAB and STATE for further branch.
522 ;STATE is will be stored in A register at BR1.

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LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
			523		
011B	215707		524	LD	HL, ITAB
011E	18F5		525	JR	BRI
			526		
			527		
			528		KDEC:
			529		;Branched by KSUBFUN table. Executed
			530		;when '-' key is pressed. Use DTAB and
			531		;STATE for further branch. STATE will be
			532		;stored in A register at BRI.
			533		
0120	216307		534	LD	HL, DTAB
0123	18F0		535	JR	BRI
			536		
			537		
			538		KGO:
			539		;Branched by KSUBFUN table. Executed
			540		;when 'GO' key is pressed. Use GTAB and
			541		;STATE for further branch. STATE will be
			542		;stored in A register at BRI.
			543		
0125	216F07		544	LD	HL, GTAB
0128	18EB		545	JR	BRI
			546		
			547		
			548		KSTEP:
			549		;Branched by table KSUBFUN. Executed
			550		;when 'STEP' key is pressed.
			551		
012A	CDE503		552	CALL	TESTM ;Check if the left 4 digits
			553		;of the display are memory address.
			554		;If not, disable all LED's as
			555		;a warning to the user. This
			556		;is done by routine IGNORE.
012D	C2BB03		557	JP	NZ, IGNORE
0130	3E80		558	LD	A, 10000000B ;This data will be output
			559		;to port B to enable
			560		;BREAK. It is done by
			561		;routine PREOUT.
0132	C3A302		562	JP	PREOUT
			563		
			564		
			565		KDATA:
			566		;Branched by table KSUBFUN. Executed
			567		;when 'DATA' key is pressed.
			568		
0135	CDE503		569	CALL	TESTM ;Check if the left 4 digits
			570		;of the display are memory address.
0138	2004		571	JR	NZ, TESTRG ;If not, branch to TESTRG
			572		;to check whether the display
			573		;is register or not.
013A	CDOB04		574	CALL	MEMDP2 ;If yes, display the data of
			575		;that address and set STATE
			576		;to 2.
013D	C9		577	RET	
013E	FE08		578	TESTRG CP	8 ;check if the status is 8 or 9
			579		; (RGAD or RGDA).
0140	DABB03		580	JP	C, IGNORE ;If not, ignore this key and

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LOC OBJ CODE M STMT SOURCE STATEMENT

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0143 CD7704 581 ;send out a warning message.
582 CALL REGDP9 ;If yes, display register and
583 ;set status to 9 (RGDA).
0146 C9 584 RET
585
586 ;
587 KSBR:
588 ;Branched by table KSUBFUN. Executed
589 ;when 'SBr' key (set break point) is
590 ;pressed.
591
0147 CDE503 592 CALL TESTM ;Check if the display is of
593 ;'address-data' form.
014A C2BB03 594 JP NZ,IGNORE ;If not, ignore this key and
595 ;send out a warning message.
014D 2ADE1F 596 LD HL,(ADSAVE) ;If yes, get the address
597 ;being display now.
0150 CDF605 598 CALL RAMCHK ;Check if this address is
599 ;in RAM.
0153 C2BB03 600 JP NZ,IGNORE ;If not, ignore the 'SBR' key
601 ;and send out a warning message.
0156 22E01F 602 LD (BRAD),HL ;If yes, set this address as
603 ;a break point.
0159 CDOB04 604 CALL MEMDP2 ;Display the data of break
605 ;address and set STATE to
606 ;2 (DA).
015C C9 607 RET
608
609 ;
610 KINS:
611 ;Branched by table KSUBFUN. Executed
612 ;when 'Ins' key (insert) is pressed.
613
015D CDE503 614 CALL TESTM ;Check if the display is of
615 ;'address-data' form now.
0160 C2BB03 616 JP NZ,IGNORE ;If not, ignore the 'INS' key
617 ;and send out a warning message.
0163 2ADE1F 618 LD HL,(ADSAVE) ;If yes, get the address being
619 ;displayed now.
620
0166 00 621 NOP
622
0167 22AF1F 623 LD (STEPBF),HL ; Store this address in
624 ;STEPBF and the next address.
625 ;in STEPBF+4 for later use.
016A 23 626 INC HL
016B 22B31F 627 LD (STEPBF+4),HL
016E CDF605 628 CALL RAMCHK ;Check if the address to be
629 ;inserted is in RAM.
0171 C2BB03 630 JP NZ,IGNORE ;If not, ignore the 'INS' key
631 ;and send out a warning message.
632 ;If the address to be inserted
633 ;is in 1800-1DFF,store 1DFE into
634 ;STEPBF+2
635 ;Otherwise, ignore the 'INS' key.
636 ;This is done by the following
637 ;instructions.
0174 11FE1D 638 LD DE,1DFEH

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LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
0177	7C	639	LD	A,H
0178	FE1E	640	CP	1EH
017A	3807	641	JR	C,SKIPH1
017C	FE20	642	CP	20H
017E	DABB03	643	JP	C,IGNORE
0181	1627	644	LD	D,27H
0183	ED53B11F	645	SKIPH1 LD	(STEPBF+2),DE
		646		
		647		;When one byte is inserted at some
		648		;address, all data below this address
		649		;will be shifted down one position.
		650		;The last location will be shifted out
		651		;and therefore lost.
		652		;The RAM is divided into 3 blocks as
		653		;insert is concerned. They are:
		654		;1800-1DFF,1E00-1FFF and 2000-27FF
		655		;The 2 nd block cannot be inserted and
		656		;is usually used as data bank. System
		657		;data that of course cannot be shifted
		658		;are also stored in this bank. Each
		659		;block is independent of the other when
		660		;shift is performed, i.e. the data
		661		;shifted out of the first block will not
		662		;be propagated to next block.
		663		;The shift is accomplished by block
		664		;transfer, i.e. MOVE. This is the
		665		;job of subroutine GMV.
		666		;Routine GMV needs 3 parameters which
		667		;are stored in step-buffer (STEPBF):
		668		;STEPBF: starting address (2 bytes);
		669		;STETBF+2: ending address (2 bytes);
		670		;STEPBF+4: destination address (2 bytes).
		671		
0187	CDE402	672	DOMV CALL	GMV
018A	AF	673	XOR	A
		674		;After the RAM has been shifted down,
		675		;the data of the address to be inserted
		676		;is cleared to zero. This is done by
		677		;the next two instructions. Register
		678		;DE contain inserted address after GMV
		679		;is performed.
018B	12	679	LD	(DE),A
018C	2AB31F	680	LD	HL,(STEPBF+4) ;Store the data in (STEPBF+4)
018F	22DE1F	681	LD	(ADSAVE),HL ;into (ADSAVE).
0192	CDOB04	682	CALL	MEMDP2 ;Display the address and data, also
		683		;set STATE to 2.
0195	C9	684	RET	
		685		;
		686		KDEL:
		687		;Branched by table KSUBFUN. Executed
		688		;when 'Del' (delete) key is pressed.
		689		
0196	CDE503	690	CALL	TESTM ;Check if the display is of
		691		;'address-data' form.
0199	C2BB03	692	JP	NZ,IGNORE ;If not, ignore the 'Del' key and
		693		;send out a warning message.
		694		;'Delete' is quite similar to
		695		;'Insert', except that the memory
		696		;is shifted up instead of shifted

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LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
			697		;down. See the comments on
			698		;routine KINS for detail.
019C	2ADE1F		699	LD	HL,(ADSAVE) ;Get the address being displayed
			700		;now. This is the address to
			701		;be deleted.
			702		
			703		
019F	00		704	NOP	
			705		
01A0	22B31F		706	LD	(STEPBF+4),HL
01A3	CDF605		707	CALL	RAMCHK ;Check if the address is in RAM.
01A6	C2BB03		708	JP	NZ,IGNORE ;If not, ignore this key and
			709		;send out a warning message.
			710		;Following instructions prepare the
			711		;parameters for routine GMV in step-
			712		;buffer. Refer to routine KINS for
			713		;detail.
01A9	11001E		714	LD	DE,1E00H
01AC	7C		715	LD	A,H
01AD	FE1E		716	CP	1EH
01AF	3807		717	JR	C,SKIPH2
01B1	FE20		718	CP	20H
01B3	DABB03		719	JP	C,IGNORE
01B6	1628		720	LD	D,28H
01B8	ED53B11F		721	SKIPH2 LD	(STEPBF+2),DE
01BC	23		722	INC	HL
01BD	22AF1F		723	LD	(STEPBF),HL
01C0	18C5		724	JR	DOMV
			725		
			726		;
			727		*****
			728		KPC:
			729		; Branched by table KFUN. Executed when
			730		; 'PC' key is pressed.
01C2	2ADC1F		731	LD	HL,(USERPC) ;Store the user's program
01C5	22DE1F		732	LD	(ADSAVE),HL ;counter into (ADSAVE)
01C8	CDOB04		733	CALL	MEMDP2 ;Routine MEMDP2 displays the address
			734		;in (ADSAVE) and its data. It also
			735		;set the STATE to 2.
01CB	C9		736	RET	
			737		;
			738		KCBR:
			739		; Branched by table KFUN. Executed when
			740		; 'CBR' (clear break point) key is pressed.
			741		
01CC	CDDE03		742	CALL	CLRBR ;Call subroutine CBRBR to clear
			743		;break point. When returned, the HL
			744		;register will contain FFFF.
01CF	22DE1F		745	LD	(ADSAVE),HL ;Store FFFF into (ADSAVE)
01D2	CDOB04		746	CALL	MEMDP2 ;Display address and its data. Also
			747		;set STATE to 2.
01D5	C9		748	RET	
			749		;
			750		KREG:
			751		; Branched by table KFUN. Executed when
			752		; 'Reg' key is pressed.
01D6	DD21CA07		753	LD	IX,REG_ ;Routine SCAN uses IX as a pointer
			754		;for display buffer. Set IX to REG

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LOC   OBJ CODE M STMT SOURCE STATEMENT
01DA  CDC404      755                ;will make SCAN displays 'Reg-
          756                CALL   FCONV   ;Decode user's flag F and F' to
          757                ;binary display format. This
          758                ;format will be used later, when
          759                ;user requires the monitor to
          760                ;display decoded flag by pressing
          761                ;keys 'SZXH', 'XPNC',...
01DD  C9          762                RET
          763                ;
          764                KADDR:
          765                ; Branched by KFUN table. Executed when
          766                ; 'Addr' key is pressed.
          767
01DE  CD0204     768                CALL   MEMDPI ;Display the address stored in
          769                ;(ADSAVE) and its data. Set STATE
          770                ;to 1 (AD).
01E1  C9          771                RET
          772                ;
          773                ; Function Move, Relative, Read-tape and
          774                ; Write-tape require from one to three
          775                ; parameters. They are stored in STEPBF
          776                ; (step buffer). STMINOR (minor status)
          777                ; contains the number of parameters has been
          778                ; entered. For Move and Relative, the
          779                ; default value of the first parameter is
          780                ; the address stored in (ADSAVE). There
          781                ; is no default value for the first parameter
          782                ; (filename) of Read- and Write-tape. When the
          783                ; function keys are pressed, STMINOR is automatically
          784                ; reset to 0.
          785                ;
          786
          787                KMV:
          788                ; Branched by table KFUN. Executed when
          789                ; 'Move' key is pressed.
          790                KRL:
          791                ; Branched by table KFUN. Executed when
          792                ; 'Rela' (relative) key is pressed.
01E2  2ADE1F     793                LD     HL,(ADSAVE) ;Store the contents of ADSAVE
          794                ;into STEPBF as default value
          795                ;of first parameter.
01E5  22AF1F     796                LD     (STEPBF),HL
          797                KWT:
          798                ; Branched by table KFUN. Executed
          799                ; when 'WRtape' key is pressed.
          800
          801                KRT:
          802                ; Branched by table KFUN. Executed when
          803                ; 'RDtape' key is pressed.
          804
01E8  CD3A04     805                CALL   STEPDP ;Display the parameter that
          806                ;is being entered now by calling
          807                ;subroutine STEPDP.
01EB  C9          808                RET
          809                ;
          810                ;*****
          811                ; The following subroutines with name H???
          812                ; are the service routine for hexadecimal

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LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
		813		; keys corresponding to each STATE. They
		814		; are all branched by table HTAB and STATE.
		815		
01EC	C3BB03	816	HFIX JP	IGNORE ;When the display is fixed pattern
		817		;hexadecimal keys are illegal.
		818		;Disable all LED's as a warning
		819		;message to the user. This is what
		820		;routine IGNORE does.
		821		;
01EF	2ADE1F	822	HDA LD	HL,(ADSAVE) ;Get the address being displayed
		823		;now from (ADSAVE)
01F2	CDF605	824	CALL	RAMCHK ;Check if it is in RAM.
01F5	C2BB03	825	JP	NZ,IGNORE ;If not, ignore this key and
		826		;send out a warning message.
01F8	CDEE03	827	CALL	PRECL1 ;If this is the first hexadecimal
		828		;key entered after function or sub-
		829		;function key,reset the data of that
		830		;address to 0. (by routine PERCL1)
01FB	79	831	LD	A,C ;The key-code is saved in C at
		832		;routine KHEX. Restore it to A.
01FC	ED6F	833	RLD	;Rotate the key-code (4 bits) into
		834		;the address obtained above. (in HL)
01FE	CDOB04	835	CALL	MEMDP2 ;Display the address and data,
		836		;then set STATE to 2 (DA).
0201	C9	837	RET	
		838		;
0202	21DE1F	839	HAD: LD	HL,ADSAVE
0205	CDFA03	840	CALL	PRECL2 ;If this is the first hexadecimal
		841		;key after function key is entered,
		842		;set the contents of ADSAVE to 0.
0208	79	843	LD	A,C ;The key-code is saved in C
		844		;by routine KHEX.
		845		;The next three instructions shift
		846		;the address being displayed by
		847		;one digit.
0209	ED6F	848	RLD	
020B	23	849	INC	HL
020C	ED6F	850	RLD	
020E	CD0204	851	CALL	MEMDP1 ;Display the address and its
		852		;data. Also, set STATE to 1.
0211	C9	853	RET	
		854		;
		855	HRGAD:	
		856	HRGFIX:	
0212	79	857	LD	A,C
0213	DD21B61F	858	LD	IX,DISPBF
0217	21E31F	859	LD	HL,STMINOR
021A	87	860	ADD	A,A ;The key-code is the register
		861		;name. Double it and store it
		862		;into STMINOR.
021B	77	863	LD	(HL),A
021C	CD7304	864	CALL	REGDP8 ;Display register and set
		865		;STATE to 8. (RGAD)
021F	C9	866	RET	
		867		;
		868	HRT:	
		869	HWT:	
		870	HRL:	

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LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
0220	CD5504	871	HMV:	CALL LOCSTBF ;Use STMINOR and STEPBF
		872		;to calculate the address
		873		;of current parameter in
		874		;step buffer.
0223	CDFA03	875		CALL PRECL2 ;If this is the first hex
		876		;key entered, cleared the
		877		;parameter (2 bytes) by
		878		;PRECL2.
0226	79	879		LD A,C ;C contains the key-code.
		880		;Rotate the parameter (2 bytes)
		881		;1 digit left with the key-code.
0227	ED6F	882		RLD
0229	23	883		INC HL
022A	ED6F	884		RLD
022C	CD3A04	885		CALL STEPDP ;Display the parameter.
022F	C9	886		RET
		887		;
0230	CDBB04	888	HRGDA	CALL LOCRGBF ;Calculate the address of
		889		;the register being modified.
0233	CDEE03	890		CALL PRECL1 ;If this is the first hex
		891		;key entered. Clear the register
		892		;(1 byte) by PRECL1.
0236	79	893		LD A,C ;Rotate user's register (1 byte)
		894		;1 digit left with the key-code
		895		;stored in C.
0237	ED6F	896		RLD
0239	CD7704	897		CALL REGDP9 ;Display the register and set
		898		;STATE to 9 (RGDA).
023C	C9	899		RET
		900		;
		901		;*****
		902		;The following routines with name
		903		;I???? are the service routines for
		904		; '+' key corresponding to each STATE.
		905		; They are all branched by table ITAB
		906		; and STATE.
		907		;
		908	IFIX:	
		909	IRGFIX:	
023D	C3BB03	910		JP IGNORE ; '+' key is illegal for state
		911		; FIX or RGFIX, ignore it.
		912		;
		913	IAD:	
0240	2ADE1F	914	IDA:	LD HL,(ADSAVE) ;Increase the address being
		915		;displayed now (in ADSAVE)
		916		;by 1.
0243	23	917		INC HL
0244	22DE1F	918		LD (ADSAVE),HL
0247	CD0B04	919		CALL MEMDP2 ;Display the address and data,
		920		;then set the STATE to 2.
024A	C9	921		RET
		922		;
		923	IRT:	
		924	IWT:	
		925	IRL:	
024B	21E31F	926	IMV:	LD HL,STMINOR ;STMINOR contains the
		927		;parameter count, increment
		928		;it by one.

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LOC OBJ CODE M STMT SOURCE STATEMENT

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024E 34          929          INC      (HL)
024F CD5F04     930          CALL    LOCSTNA ;Check if the count is
                                931          ;overflowed.
0252 2004      932          JR      NZ, ISTEP ;If not overflowed, continue
                                933          ;at ISTEP.
0254 35        934          DEC      (HL) ;Otherwise, restore the count
                                935          ;and ignore the '+' key.
0255 C3BB03    936          JP      IGNORE
0258 CD3A04    937 ISTEP CALL    STEPDP ;Display the parameter at
                                938          ;step buffer.
025B C9        939          RET
                                940          ;
                                941          IRGAD:
025C 21E31F    942 IRGDA: LD      HL,STMINOR ;In these states, the STMINOR
                                943          ;contains the register name.
                                944          ;Increase it by 1. If it
                                945          ;reaches the last one, reset
                                946          ;it to the first one (0).
025F 34        947          INC      (HL)
0260 3E1F      948          LD      A,1FH
0262 BE        949          CP      (HL)
0263 3002      950          JR      NC, IRGNA
0265 3600      951          LD      (HL),0
0267 CD7704    952 IRGNA CALL    REGDP9 ;Display the register and
                                953          ;set STATE to 9.
026A C9        954          RET
                                955          ;
                                956          ;*****
026B C3BB03    957          ;The following routines with name
                                958          ;D???? are the service routines for
                                959          ;'-' key corresponding to each state.
                                960          ;They are all branched by table DTAB
                                961          ;and STATE.
                                962          ;
                                963          DFIX:
                                964          DRGFIX:
026E 2ADE1F    965          JP      IGNORE ;'-' key is illegal for
                                966          ;these states. Ignore it.
                                967          ;
                                968          DAD:
0271 2B        969          DDA: LD      HL,(ADSAVE) ;Decrease the address being
                                970          ;displayed now (in ADSAVE)
                                971          ;by one.
0272 22DE1F    972          DEC      HL
0275 CDOB04    973          LD      (ADSAVE),HL
                                974          CALL    MEMDP2 ;Display the address and data,
                                975          ;set STATE to 2 (DA).
0278 C9        976          RET
                                977          ;
                                978          DRT:
                                979          DWT:
                                980          DRL:
0279 21E31F    981          DMV: LD      HL,STMINOR ;In these states, STMINOR
                                982          ;contains the parameter count.
                                983          ;Decrease it by one. If overflow
                                984          ;occurs, restore STMINOR and
                                985          ;ignore the '-' key. Otherwise
                                986          ;continue at DSTEP.

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LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
027C	35		987	DEC	(HL)
027D	CD5F04		988	CALL	LOCSTNA
0280	2004		989	JR	NZ, DSTEP
0282	34		990	INC	(HL)
0283	C3BB03		991	JP	IGNORE
0286	CD3A04		992	DSTEP CALL	STEPDP ;Display the parameter.
0289	C9		993	RET	
			994		;
			995	DRGAD:	
028A	21E31F		996	DRGDA: LD	HL, STMINOR ;In these states, STMINOR
			997		;contains the register name.
			998		;Decrease it by one.' If it
			999		;goes below zero, set it to
			1000		;the highest value (1F).
028D	35		1001	DEC	(HL)
028E	3E1F		1002	LD	A, 01FH
0290	BE		1003	CP	(HL)
0291	3002		1004	JR	NC, DRGNA
0293	361F		1005	LD	(HL), 1FH
0295	CD7704		1006	DRGNA CALL	REGDP9 ;Display the register and
			1007		;set STATE to 9.
0298	C9		1008	RET	
			1009		;
			1010		;*****
			1011		;The following routines with name
			1012		;G???? are the service routines for
			1013		;'GO' key corresponding to each
			1014		;state. They are all branched by
			1015		;table GTAB and STATE.
			1016		
			1017	GFIX:	
			1018	GRGFIX:	
			1019	GRGAD:	
0299	C3BB03		1020	GRGDA: JP	IGNORE ;'GO' key is illegal for
			1021		;these states. Ignore it.
			1022		;
			1023	GAD:	
029C	2AE01F		1024	GDA: LD	HL, (BRAD) ;Get the address of break
			1025		;point.
029F	36EF		1026	LD	(HL), 0EFH ;Instruction RST 28H.
			1027		;The content of break address
			1028		;is changed to RST 28H before
			1029		;the control is transferred to
			1030		;user's program. This
			1031		;will cause a trap when user's
			1032		;PC passes this point.
02A1	3EFF		1033	LD	A, OFFH ;Save FF into TEMP. This data
			1034		;will be output to port B later.
			1035		;FF is used to disable break point.
02A3	32EA1F		1036	PREOUT LD	(TEMP), A ;Store A into TEMP.
02A6	3AD21F		1037	LD	A, (USERIF) ;Save two instructions into
			1038		;TEMP and TEMP+1. These two
			1039		;instructions will be executed
			1040		;later. If the user's IFF
			1041		;(interrupt flip-flop) is 1,
			1042		;the instructions are 'EI RET'.
			1043		;Otherwise, they are 'DI RET'.
02A9	CB47		1044	BIT	0, A

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LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
02AB	21FBC9		1045	LD	HL,OC9FBH ;'EI','RET'
02AE	2002		1046	JR	NZ,EIDI
02B0	2EF3		1047	LD	L,OF3H ;'DI'
02B2	22EB1F		1048	EIDI LD	(TEMP+1),HL
02B5	31BC1F		1049	LD	SP,REGBF ;Restore user's registers by
			1050		;setting SP to REGBF (register
			1051		;buffer) and continuously popping
			1052		;the stack.
02B8	F1		1053	POP	AF
02B9	C1		1054	POP	BC
02BA	D1		1055	POP	DE
02BB	E1		1056	POP	HL
02BC	08		1057	EX	AF,AF'
02BD	F1		1058	POP	AF
02BE	08		1059	EX	AF,AF'
02BF	D9		1060	EXX	
02C0	C1		1061	POP	BC
02C1	D1		1062	POP	DE
02C2	E1		1063	POP	HL
02C3	D9		1064	EXX	
02C4	DDE1		1065	POP	IX
02C6	FDE1		1066	POP	IY
02C8	ED7BD01F		1067	LD	SP,(USERSP) ;Restore user's SP.
02CC	32BD1F		1068	LD	(USERAF+1),A ;Temporarily save A
02CF	3AD31F		1069	LD	A,(USERIF+1) ;Restore user's I
02D2	ED47		1070	LD	I,A
02D4	E5		1071	PUSH	HL ;The next 3 instructions
			1072		;push the address being
			1073		;displayed now (in ADSAVE)
			1074		;onto stack without changing
			1075		;HL register. This address will be
			1076		;treated as user's new PC.
02D5	2ADE1F		1077	LD	HL,(ADSAVE)
02D8	E3		1078	EX	(SP),HL
02D9	3AEA1F		1079	LD	A,(TEMP) ;Output the data stored in
			1080		;TEMP to port B of 8255.
			1081		;This data is prepared by
			1082		;routine KSTEP or GAD or
			1083		;GDA. In first case, it is
			1084		;10111111 and will enable
			1085		;break point. In other
			1086		;cases, it is FF and will
			1087		;disable break point.
			1088		;If break is enabled, non-
			1089		;maskable interrupt will occur
			1090		;5 M1's after the OUT instruction.
02DC	D302		1091	OUT	(DIGIT),A
02DE	3ABD1F		1092	LD	A,(USERAF+1) ;1st M1,
			1093		;Restore A register.
02E1	C3EB1F		1094	JP	TEMP+1 ;2nd M1,
			1095		;Execute the two instructions
			1096		;stored in RAM. They are:
			1097		; EI (or DI) ;3rd M1
			1098		; RET ;4th M1
			1099		;The starting address of user's
			1100		;program has been pushed onto
			1101		;the top of the stack. RET pops
			1102		;out this address and transfers

MPF-I

LOC OBJ CODE M STMT SOURCE STATEMENT

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1103                                     ;control to it. The first M1
1104                                     ;of user's program will be the
1105                                     ;5th M1 after OUT. If break point
1106                                     ;is enabled, NMI will occur after
1107                                     ;this instruction is completed.
1108                                     ;This is the mechanism of single
1109                                     ;step.
1110                                     ;
1111                                     ;*****
02E4 21AF1F 1112 GMV LD HL,STEPBF
02E7 CD3D05 1113 CALL GETP ;Load parameters from
1114                                     ;step buffer into registers.
1115                                     ;Also check if the parameters
1116                                     ;are legal. After GETP,
1117                                     ;HL = start address of source
1118                                     ;BC = length to MOVE.
02EA 3867 1119 JR C,ERROR ;Jump to ERROR if the
1120                                     ;parameters are illegal. (I.e., Ending
1121                                     ;address < starting address.)
02EC ED5BB31F 1122 LD DE,(STEPBF+4) ;Load destination
1123                                     ;address into DE.
02F0 ED52 1124 SBC HL,DE ;Compare HL and DE to
1125                                     ;determine move up or down.
02F2 300C 1126 JR NC,MVUP
1127                                     ;Move down:
02F4 EB 1128 EX DE,HL ;HL = destination address
02F5 09 1129 ADD HL,BC ;HL = dest. address + length
02F6 2B 1130 DEC HL ;HL = end address of dest.
02F7 EB 1131 EX DE,HL ;DE = end address of dest.
02F8 2AB11F 1132 LD HL,(STEPBF+2) ;HL = end address of source
02FB EDB8 1133 LDDR ;block transfer instruction
02FD 13 1134 INC DE ;DE = last address moved
02FE 181C 1135 JR ENDFUN ;Continue at ENDFUN.
1136 MVUP: ;Move up:
0300 19 1137 ADD HL,DE ;HL is destroyed by
1138 ;SBC HL,DE. Restore HL.
0301 EDB0 1139 LDIR ;block transfer
0303 1B 1140 DEC DE ;DE = last address moved
0304 1816 1141 JR ENDFUN ;Continue at ENDFUN.
1142 ;
1143 ;*****
0306 ED5BAF1F 1144 GRL LD DE,(STEPBF) ;Load starting address
1145                                     ;into DE.
030A 13 1146 INC DE ;Increase this address by 2.
1147                                     ;Relative address is used in
1148                                     ;instruction JR or DJNZ.
1149                                     ;The codes for them are 2 bytes.
1150                                     ;The PC is increased by 2 after
1151                                     ;opcode is fetched.
030B 13 1152 INC DE
030C 2AB11F 1153 LD HL,(STEPBF+2) ;Load destination
1154                                     ;address into HL.
030F B7 1155 OR A
0310 ED52 1156 SBC HL,DE ;Calculate difference.
0312 7D 1157 LD A,L ;Check if the offset is between
1158                                     ;+127 (007FH) and -128 (FF80H).
1159                                     ;If the offset is positive, both H
1160                                     ;and bit 7 of L must be zero; if it

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MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
      1161 ;is negative, H and bit 7 of L must
      1162 ;be FF and 1.  In both cases, adding
      1163 ;H with bit 7 of L results in 0.
0313  17      1164 RLA ;Rotate bit 7 of L into carry flag.
0314  7C      1165 LD  A,H
0315  CE00    1166 ADC A,0 ;ADD H and bit 7 of L.
0317  203A    1167 JR  NZ,ERROR ;Branch to ERROR if
      1168 ;the result is nonzero.
0319  7D      1169 LD  A,L
031A  1B      1170 DEC DE
031B  12      1171 LD  (DE),A ;Save the offset into
      1172 ;the next byte of opcode.
      1173 ;(DJNZ or JR)
      1174 ;
      1175 ENDFUN:
031C  ED53DE1F 1176 LD  (ADSAVE),DE ;Save DE into ADSAVE.
0320  CDOB04   1177 CALL MEMDP2 ;Display this address and
      1178 ;its data.  Set STATE to 2.
0323  C9      1179 RET
      1180 ;
      1181 ;*****
      1182 GWT:
0324  CD2D05   1183 CALL SUM1 ;Load parameters from
      1184 ;step buffer into registers.
      1185 ;Check if the parameters
      1186 ;are legal.  If legal, calculate
      1187 ;the sum of all data to be output
      1188 ;to tape.
0327  382A     1189 JR  C,ERROR ;Branch to ERROR if the
      1190 ;parameters are illegal. (length is
      1191 ;negative)
0329  32B51F   1192 LD  (STEPBF+6),A ;Store the checksum into
      1193 ;STEPBF+6.
032C  21A00F   1194 LD  HL,4000 ;Output 1k Hz square
      1195 ;wave for 4000 cycles.
      1196 ;Leading sync. signal.
032F  CDDE05   1197 CALL TONE1K
0332  21AF1F   1198 LD  HL,STEPBF ;Output 7 bytes starting
      1199 ;at STEPBF. (Include:
      1200 ;filename, starting, ending
      1201 ;address and checksum)
0335  010700   1202 LD  BC,7
0338  CDA705   1203 CALL TAPEOUT
033B  21A00F   1204 LD  HL,4000 ;Output 2k Hz square
      1205 ;wave for 4000 cycles.
      1206 ;Middle sync. The file name of the
      1207 ;file being read will be displayed
      1208 ;in this interval.
033E  CDE205   1209 CALL TONE2K
0341  CD3A05   1210 CALL GETPTR ;Load parameters into
      1211 ;registers. (Starting, ending and
      1212 ;length).
0344  CDA705   1213 CALL TAPEOUT ;Output user's data.
0347  21A00F   1214 LD  HL,4000 ;Output 4000 cycles of
      1215 ;2k Hz square wave.
      1216 ;(Tail sync.)
034A  CDE205   1217 CALL TONE2K
034D  ED5BB31F 1218 ENDTAPE LD  DE,(STEPBF+4) ;DE = last address

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LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
0351	18C9	1219	JR	ENDFUN ;Continue at ENDFUN.
		1220		
0353	DD21A907	1221	ERROR LD	IX,ERR ;IX points to '-Err
0357	C3D000	1222	JP	SETSTO ;Set STATE to 0 by
		1223		;branching to SETSTO.
		1224		
		1225		;*****
		1226	GRT:	
035A	2AAF1F	1227	LD	HL,(STEPBF) ;Temporarily save filename.
035D	22EA1F	1228	LD	(TEMP),HL
0360	3E40	1229	LEAD LD	A,0100000B ;decimal point
0362	D301	1230	OUT	(SEG7),A ;When searching for filename,
		1231		the display is blank initially.
		1232		;If the data read from MIC is
		1233		;acceptable 0 or 1, the display
		1234		;becomes '.....'.
0364	21E803	1235	LD	HL,1000
0367	CD8C05	1236	LEAD1 CALL	PERIOD ;The return of PERIOD
		1237		;is in flag:
		1238		; NC -- tape input is 1k Hz;
		1239		; C -- otherwise.
036A	38F4	1240	JR	C,LEAD ;Loop until leading sync.
		1241		;is detected.
036C	2B	1242	DEC	HL ;Decrease HL by one when
		1243		;one period is detected.
036D	7C	1244	LD	A,H
036E	B5	1245	OR	L ;Check if both H and L are 0.
036F	20F6	1246	JR	NZ,LEAD1 ;Wait for 1000 periods.
		1247		;The leading sync. is accepted
		1248		;if it is longer than 1000
		1249		;cycles (1 second).
0371	CD8C05	1250	LEAD2 CALL	PERIOD
0374	30FB	1251	JR	NC,LEAD2 ;Wait all leading sync. to
		1252		;pass over.
		1253		
0376	21AF1F	1254	LD	HL,STEPBF ;Load 7 bytes from
		1255		;tape into STEPBF.
0379	010700	1256	LD	BC,7
037C	CD4D05	1257	CALL	TAPEIN
037F	38DF	1258	JR	C,LEAD ;Jump to LEAD if input
		1259		;is not successful.
0381	ED5BAF1F	1260	LD	DE,(STEPBF) ;Get filename from
		1261		;step buffer.
0385	CD6506	1262	CALL	ADDRDP ;Convert it to display
		1263		;format.
0388	0696	1264	LD	B,150 ;Display it for 1.5 sec.
038A	CD2406	1265	FILEDP CALL	SCAN1
038D	10FB	1266	DJNZ	FILEDP
038F	2AEA1F	1267	LD	HL,(TEMP) ;Check if the input
		1268		;filename equals to the
		1269		;specified filename.
0392	B7	1270	OR	A
0393	ED52	1271	SBC	HL,DE
0395	20C9	1272	JR	NZ,LEAD ;If not, find the leading
		1273		;sync. of next file.
		1274		
		1275		;If filename is found,
0397	3E02	1276	LD	A,00000010B ;segment '-'


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LOC  OBJ CODE M STMT SOURCE STATEMENT
0399  D301      1277      OUT   (SEG7),A ;Display '-----'.
039B  CD3A05    1278      CALL  GETPTR  ;The parameters (starting
1279      ;ending address and check-
1280      ;sum) have been load into
1281      ;STEPBF. Load them into
1282      ;registers, calculate the block
1283      ;length and check if they are
1284      ;legal.
039E  38B3      1285      JR    C,ERROR ;Jump to ERROR if the
1286      ;parameters are illegal.
03A0  CD4D05    1287      CALL  TAPEIN ;Input user's data.
03A3  38AE      1288      JR    C,ERROR ;Jump to ERROR if input
1289      ;is not successful.
03A5  CD2D05    1290      CALL  SUM1   ;Calculate the sum of all
1291      ;input data.
03A8  21B51F    1292      LD    HL,STEPBF+6
03AB  BE        1293      CP    (HL)   ;Compare it with the
1294      ;checksum calculated by and stored
1295      ;'Wrtape'.
03AC  20A5      1296      JR    NZ,ERROR ;Jump to ERROR if not
1297      ;matched.
03AE  189D      1298      JR    ENDTAPE ;Continue at ENDTAPE.
1299      ;
1300      ;*****
1301  BRANCH:
1302  ;Branch table format:
1303  ; byte 1,2 : address of the 1st routine in
1304  ;          ; each group.
1305  ; byte 3   : difference between the address
1306  ;          ; of 1st and 1st routine, which is
1307  ;          ; of course 0.
1308  ; byte 4   : difference between the address
1309  ;          ; of 2nd and 1st routine
1310  ; byte 5   : difference between the address
1311  ;          ; of 3rd and 1st routine
1312  ;          ; ...
1313  ;          ; ...
1314  ;          ; ...
1315  ; HL : address of branch table
1316  ; A  : the routine number in its group
1317  ; Such branch table can save table length and avoid page
1318  ; (256 bytes) boundary problem.
1319
03B0  5E        1320      LD    E,(HL) ;Load the address of 1st
1321      ;routine in the group into
1322      ;DE register.
03B1  23        1323      INC   HL
03B2  56        1324      LD    D,(HL)
03B3  23        1325      INC   HL ;Locate the pointer of difference
1326      ;table.
03B4  85        1327      ADD   A,L
03B5  6F        1328      LD    L,A
03B6  6E        1329      LD    L,(HL) ;Load the address
1330      ;difference into L.
03B7  2600     1331      LD    H,0
03B9  19        1332      ADD   HL,DE ;Get routine's real address
03BA  E9        1333      JP    (HL) ;Jump to it.
1334

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MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
1335 ;*****
1336 IGNORE:
03BB 21E61F 1337 LD HL,TEST
03BE CBFE 1338 SET 7,(HL) ;Routine SCAN will check bit
1339 ;7 of TEST. If it is set,
1340 ;all LEDs will be disabled.
1341 ;This is a warning message to
1342 ;the user when a illegal key
1343 ;is entered.
03C0 C9 1344 RET
1345 ;
1346 ;*****
1347 INI:
03C1 DD21A507 1348 ; Power-up initialization.
1349 LD IX,BLANK ;BLANK is the initial pattern
1350
1351 ;Display the following
1352 ;patterns sequence, each 0.16
1353 ;seconds:
1354 ;
1355 ; ' u'
1356 ; ' uP'
1357 ; ' uPF'
1358 ; ' uPF-'
1359 ; ' uPF--'
1360 ; ' uPF--1'
1361
03C5 0E07 1362 LD C,7 ;pattern count
03C7 0610 1363 INI1 LD B,10H ;Display 0.16 second.
03C9 CD2406 1364 INI2 CALL SCAN1
03CC 10FB 1365 DJNZ INI2
03CE DD2B 1366 DEC IX ;next pattern
03D0 0D 1367 DEC C
03D1 20F4 1368 JR NZ,INI1
1369 ;
03D3 3EA5 1370 LD A,PWCODE
03D5 C3B306 1371 JP INI3
03D8 216600 1372 INI4 LD HL,NMI
03DB 22EE1F 1373 LD (IMIAD),HL ;Set the service routine
1374 ;of RST 38H to NMI, which is the
1375 ;nonmaskable interrupt service
1376 ;routine for break point and
1377 ;single step.
1378 CLRBR:
1379 ; Clear break point by setting
1380 ; the break point address to
1381 ; FFFF. This is a non-existent
1382 ; address, so break can never
1383 ; happen.
1384
03DE 21FFFF 1385 LD HL,OFFFPH
03E1 22E01F 1386 LD (BRAD),HL
03E4 C9 1387 RET
1388 ;
1389 TESTM:
1390 ; Check if the display is of 'address-data'
1391 ; form, i.e. STATE 1 or 2.
1392 ; The result is stored in zero flag.

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LOC	OBJ CODE M	STMT	SOURCE STATEMENT
		1393	; Z: yes
		1394	; NZ: no
		1395	
03E5	3AE41F	1396	LD A,(STATE)
03E8	FE01	1397	CP 1
03EA	C8	1398	RET Z
03EB	FE02	1399	CP 2
03ED	C9	1400	RET
		1401	;
		1402	PRECL1:
		1403	; Pre-clear 1 byte.
		1404	; If bit 0 of TEST is not 0, load 0 into (HL). Bit 0 of
		1405	; TEST is cleared after check.
		1406	; Only AF register are destroyed.
		1407	
03EE	3AE61F	1408	LD A,(TEST)
03F1	B7	1409	OR A ;Is bit 0 of TEST zero?
03F2	C8	1410	RET Z
03F3	3E00	1411	LD A,0
03F5	77	1412	LD (HL),A ;Clear (HL)
03F6	32E61F	1413	LD (TEST),A ;Clear TEST too.
03F9	C9	1414	RET
		1415	;
		1416	PRECL2:
		1417	; Pre-clear 2 bytes.
		1418	; If bit 0 of TEST is nonzero, clear (HL)
		1419	; and (HL+1).
		1420	; Only AF register are destroyed.
		1421	
03FA	CDEE03	1422	CALL PRECL1
03FD	C8	1423	RET Z
03FE	23	1424	INC HL
03FF	77	1425	LD (HL),A
0400	2B	1426	DEC HL
0401	C9	1427	RET
		1428	;
		1429	*****
		1430	; Memory display format: (address-data)
		1431	
		1432	; i) A.A.A.A. D D -- State is AD. four decimal points
		1433	; under the address field indicate
		1434	; that the numeric key entered will
		1435	; be interpreted as memory address.
		1436	; ii) A A A A D.D.-- State is DA. Two decimal points
		1437	; under the data field indicate
		1438	; the monitor is expecting user to
		1439	; enter memory data.
		1440	; iii) A.A.A.A. D.D.-- Six decimal points indicate the
		1441	; address being displayed is set
		1442	; as a break point.
		1443	
		1444	MEMDPI:
0402	3E01	1445	LD A,1 ;Next STATE =1
0404	0604	1446	LD B,4 ;4 decimal points active
0406	21B81F	1447	LD HL,DISPBF+2 ;The first active decimal
		1448	;point is in DISPBF+2, the
		1449	;last in DESPBF+5.
0409	1807	1450	JR SAV12 ;Continue at SAV12.

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LOC  OBJ CODE M STMT SOURCE STATEMENT
      1451 MEMDP2:
040B  3E02      1452      LD      A,2      ;Next STATE = 2
040D  0602      1453      LD      B,2      ;2 active decimal points
040F  21B61F    1454      LD      HL,DISPBF ;1st decimal point is in
      1455                      ;DISPBF, 2nd in DISPBF+1.
0412  32E41F    1456 SAV12 LD      (STATE),A ;Update STATE
0415  D9         1457      EXX                      ;Save register HL,BC,DE.
0416  ED5BDE1F  1458      LD      DE,(ADSAVE) ;The address to be
      1459                      ;displayed is stored in
      1460                      ;(ADSAVE). Load it into
      1461                      ;DE register.
041A  CD6506    1462      CALL   ADDRDP ;Convert this address to
      1463                      ;display format and store it
      1464                      ;into DISPBF+2 & DISPBF+5.
041D  1A         1465      LD      A,(DE) ;Load the data of this
      1466                      ;address into A register.
041E  CD7106    1467      CALL   DATADP ;Convert this data to
      1468                      ;display format and store it
      1469                      ;into DISPBF & DISPBF+1.
      1470 BRTEST:
      1471 ; The next 3 instructions serve to refresh the
      1472 ; data at break address every time memory is
      1473 ; displayed.
0421  2AE01F    1474      LD      HL,(BRAD) ;Get break point address.
0424  7E         1475      LD      A,(HL) ;Get the data of this
      1476                      ;address into A register.
0425  32E21F    1477      LD      (BRDA),A ;Store it into BRDA (break data).
0428  B7         1478      OR      A
0429  ED52      1479      SBC   HL,DE ;Check if the address to
      1480                      ;be displayed is break point.
042B  2006      1481      JR    NZ,SETPT1 ;If not, jump to SETPT1.
042D  0606      1482      LD      B,6 ;6 active decimal points.
042F  21B61F    1483      LD      HL,DISPBF ;1st decimal point is in
      1484                      ;DISPBF; 6th in DISPBF+5.
0432  D9         1485      EXX
0433  D9         1486 SETPT1 EXX                      ;Restore HL,BC,DE.
0434  CBF6      1487 SETPT SET    6,(HL) ;Set decimal points.
      1488                      ;Count in B, first address
      1489                      ;in HL register.
0436  23         1490      INC   HL
0437  10FB      1491      DJNZ  SETPT
0439  C9         1492      RET
      1493 ;
      1494 ;*****
      1495 ; Step display format: (this format is used when user is
      1496 ; entering parameters for Move, Rela, WRtape, RDtape.)
      1497 ;
      1498 ; P.P.P.P. - N
      1499 ;
      1500 ; 'P' is the digit of parameter. Four decimal points
      1501 ; indicate P's are being modified now. N is the mnemonic of
      1502 ; the parameter:
      1503 ; i) Move S -- starting address
      1504 ; E -- ending address
      1505 ; D -- destination address
      1506 ; ii) Rela S -- source address
      1507 ; D -- destination address
      1508 ; iii) WRtape F -- file name

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LOC	OBJ CODE	M	STMT	SOURCE STATEMENT
			1509	; S -- starting address
			1510	; E -- ending address
			1511	; iv) RDtape F -- file name
			1512	.
			1513	STEPDP:
			1514	;Display step buffer and its parameter name.
			1515	;Input: STATE
			1516	; STMIONR (parameter count)
			1517	;register destroyed: AF,BC,DE,HL
			1518	
043A	CD5504		1519	CALL LOCSTBF ;Get parameter address
043D	5E		1520	LD E,(HL) ;Load parameter into DE
043E	23		1521	INC HL
043F	56		1522	LD D,(HL)
0440	CD6506		1523	CALL ADDRDP ;Convert this parameter to
			1524	;display format (4 digits)
			1525	;and store it into DISPBF+2
			1526	; c DISPBF+5.
0443	21B81F		1527	LD HL,DISPBF+2 ;Set 4 decimal points.
			1528	;From DISPBF+2 to DISPBF+5.
0446	0604		1529	LD B,4
0448	CD3404		1530	CALL SETPT
044B	CD5F04		1531	CALL LOCSTNA ;Get parameter name.
044E	6F		1532	LD L,A
044F	2602		1533	LD H,2 ;Pattern '-' for 2nd rightmost
			1534	;digit.
0451	22B61F		1535	LD (DISPBF),HL
0454	C9		1536	RET
			1537	;
			1538	LOCSTBF:
			1539	;Get the location of parameter.
			1540	; address = STEPBF + STMIONR*2
			1541	;register destroyed: AF,HL
			1542	
0455	3AE31F		1543	LD A,(STMIONR) ;Get parameter count.
0458	87		1544	ADD A,A ;Each parameter has 2 bytes.
0459	21AF1F		1545	LD HL,STEPBF ;Get base address.
045C	85		1546	ADD A,L
045D	6F		1547	LD L,A
045E	C9		1548	RET
			1549	;
			1550	LOCSTNA:
			1551	;Get parameter name.
			1552	;Input: STATE, STMIONR
			1553	;Output: parameter name in A, and Z flag.
			1554	
			1555	;register destroyed: AF,DE
045F	3AE41F		1556	LD A,(STATE) ;Get STATE.
			1557	;Possible states are:
			1558	;4,5,6,7. (Move, Rel,
			1559	;Wrtape, RDtape)
0462	D604		1560	SUB 4 ;Change 4,5,6,7 to
			1561	;0,1,2,3.
0464	87		1562	ADD A,A ;Each state has 4 bytes for names.
0465	87		1563	ADD A,A
0466	11BC07		1564	LD DE,STEPTAB
0469	83		1565	ADD A,E
046A	5F		1566	LD E,A ;Now, DE contains the

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LOC	OBJ CODE M	STMT	SOURCE STATEMENT
		1567	;address of 1st name
		1568	;for each state.
046B	3AE31F	1569	LD A,(STMINOR) ;Get parameter count
046E	83	1570	ADD A,E ;DE <--- DE + A
046F	5F	1571	LD E,A
0470	1A	1572	LD A,(DE) ;Get parameter name.
0471	B7	1573	OR A ;Change zero flag. If the
		1574	;returned pattern (in A) is
		1575	;zero, the '+' or '-' must
		1576	;have been pressed beyond legal
		1577	; parameter boundary. (Check if
		1578	;parameter name got from STEPTAB
		1579	;is zero)
0472	C9	1580	RET
		1581	;
		1582	*****
		1583	; Register display format:
		1584	;
		1585	; i) X X X X Y Y -- State is REGAD. The numeric data
		1586	; entered is interpreted as
		1587	; register name.
		1588	; YY is the register name, the
		1589	; data of that register pair is
		1590	; XXXX.
		1591	;
		1592	; ii) X X X.X. Y Y or
		1593	; iii) X.X.X X Y Y -- State is REGDA. The unit of
		1594	; register modification is byte.
		1595	; The numeric data entered will
		1596	; change the byte with decimal
		1597	; points under it. Decimal points
		1598	; can be moved by '+' of '-' keys.
		1599	;
		1600	REGDP8:
		1601	; Display register and set STATE to 8.
		1602	;
0473	3E08	1603	LD A,8 ;Next state = 8
0475	1802	1604	JR RGSTIN
		1605	;
		1606	REGDP9:
		1607	; Display register and set STATE to 9.
		1608	;
0477	3E09	1609	LD A,9 ;Next state = 9
		1610	;
		1611	RGSTIN:
		1612	; Update STATE by register A.
		1613	; Display user's register (count
		1614	; contained in STMINOR).
		1615	; register destroyed: AF,BC,DE,HL
		1616	;
0479	32E41F	1617	LD (STATE),A ;Update STATE.
047C	3AE31F	1618	LD A,(STMINOR) ;Get register count.
047F	CB87	1619	RES O,A ;Registers are displayed by
		1620	;pair. Find the count
		1621	;of pair leader. (count of
		1622	;the lower one)
0481	47	1623	LD B,A ;Temporarily save A.
0482	CDAE04	1624	CALL RGNADP ;Find register count.

MPF-I

LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
		1625		;Store them into DISPBF
		1626		;and DISPBF+1.
0485	78	1627	LD	A,B ;Restore A (register pair leader).
0486	CDBE04	1628	CALL	LOCRG ;Get the address of
		1629		;user's register.
0489	5E	1630	LD	E,(HL) ;Get register data. (2 bytes)
048A	23	1631	INC	HL
048B	56	1632	LD	D,(HL)
048C	ED53DE1F	1633	LD	(ADSAVE),DE ;Convert them to display
		1634		;format and store into
		1635		;display buffer.
0490	CD6506	1636	CALL	ADDRDP
0493	3AE41F	1637	LD	A,(STATE)
0496	FE09	1638	CP	9 ;If STATE equals to 9 (RGDA),
		1639		;set 2 decimal points.
		1640		;Otherwise return here.
0498	CO	1641	RET	NZ
0499	21B81F	1642	LD	HL,DISPBF+2
049C	3AE31F	1643	LD	A,(STMINOR) ;Get register name.
049F	CB47	1644	BIT	0,A ;If this register is
		1645		;group leader, set decimal
		1646		;points of two central digits.
		1647		;Otherwise set two left digits.
04A1	2802	1648	JR	Z,LOCPT
04A3	23	1649	INC	HL
04A4	23	1650	INC	HL
04A5	CBF6	1651	LOCPT SET	6,(HL) ;Set decimal points of
		1652		;(HL) and (HL+1)
04A7	23	1653	INC	HL
04A8	CBF6	1654	SET	6,(HL)
04AA	CDC404	1655	CALL	FCONV ;Convert user's flag (F,F')
		1656		;to binary display format.
04AD	C9	1657	RET	
		1658		;
		1659		RGNADP:
		1660		; Get the patterns of register names and
		1661		; store them into DISPBF and DISPBF+1.
		1662		; Input: A contains register count of
		1663		; pair leader.
		1664		; register destroyed: AF,DE,HL
		1665		;
04AE	21D007	1666	LD	HL,RTAB ;Get address of pattern
		1667		;table.
04B1	85	1668	ADD	A,L
04B2	6F	1669	LD	L,A
04B3	5E	1670	LD	E,(HL) ;Get first pattern.
04B4	23	1671	INC	HL
04B5	56	1672	LD	D,(HL) ;Get 2nd pattern.
04B6	ED53B61F	1673	LD	(DISPBF),DE
04BA	C9	1674	RET	
		1675		;
		1676		LOCRGBF:
		1677		; Get the address of user's register.
		1678		; Register name contained in STMINOR.
		1679		; Destroys HL, AF.
		1680		;
04BB	3AE31F	1681	LD	A,(STMINOR)
04BE	21BC1F	1682	LOCRG LD	HL,REGBF

MPF-I					
LOC	OBJ CODE M	STMT	SOURCE	STATEMENT	
04C1	85	1683	ADD	A,L	
04C2	6F	1684	LD	L,A	
04C3	C9	1685	RET		
		1686			;
		1687	FCONV:		
		1688			; Encode or decode user's flag register.
		1689			; STMINOR contains the name of the flag
		1690			; being displayed now.
		1691			; register destroyed: AF,BC,HL.
		1692			
04C4	3AE31F	1693	LD	A,(STMINOR)	;Get register name.
04C7	B7	1694	OR	A	;Clear carry flag.
04C8	1F	1695	RRA		;name of I register: 17H,
		1696			;name of IFF: 16H.
		1697			;Rotate right one bit, both
		1698			;become OBH.
04C9	FE0B	1699	CP	OBH	
04CB	2809	1700	JR	Z,FLAGX	;Jump to FLAGX if
		1701			;I or IFF is being
		1702			;displayed now.
04CD	4F	1703	LD	C,A	;Otherwise, mask out bit
		1704			;1 to bit 7 of user's IFF.
		1705			;IFF is only 1 bit, monitor
		1706			;use one byte to store it,
		1707			;masking out bit 1¢7 is to
		1708			;ignore the useless bits.
		1709			;This is done only when the
		1710			;user is not modifying IFF.
		1711			;If user is modifying IFF,
		1712			;monitor will display whatever
		1713			;he enters, even if bit 1¢7
		1714			;are not all zero.
		1715			;A register is not changed
		1716			;after doing this.
04CE	21D21F	1717	LD	HL,USERIF	
04D1	7E	1718	LD	A,(HL)	
04D2	E601	1719	AND	0000001B	
04D4	77	1720	LD	(HL),A	
04D5	79	1721	LD	A,C	
04D6	FE0C	1722	FLAGX CP	OCH	;If STMINOR contains
		1723			;the name of SZXH, XPNC,
		1724			;SZXH' or XPNC', after
		1725			;rotating right one bit
		1726			;it will be greater than
		1727			;or equal to OCH.
		1728			;Decode user's flag if it
		1729			;is not being modified now,
		1730			;encode it otherwise.
04D8	301F	1731	JR	NC,FCONV2	
04DA	3ABC1F	1732	FCONV1 LD	A,(USERAF)	;Get user's F register.
04DD	CD1805	1733	CALL	DECODE	;Decode upper 4 bits.
04E0	22D41F	1734	LD	(FLAGH),HL	
04E3	CD1805	1735	CALL	DECODE	;Decode lower 4 bits.
04E6	22D61F	1736	LD	(FLAGL),HL	
04E9	3AC41F	1737	LD	A,(UAFP)	;Get user's F' register.
04EC	CD1805	1738	CALL	DECODE	
04EF	22D81F	1739	LD	(FLAGHP),HL	
04F2	CD1805	1740	CALL	DECODE	

MPF-I

LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
04F5	22DA1F		1741	LD	(FLAGLP),HL
04F8	C9		1742	RET	
04F9	2AD41F		1743	FCONV2 LD	HL,(FLAGH) ;Get the binary form
			1744		;of 4 upper bits of
			1745		;user's F register.
04FC	CD2305		1746	CALL	ENCODE ;Encode it.
04FF	2AD61F		1747	LD	HL,(FLAGL) ;Encode 4 lower bits.
0502	CD2305		1748	CALL	ENCODE
0505	32BC1F		1749	LD	(USERAF),A ;Save the encoded
			1750		;result into USERAF.
0508	2AD81F		1751	LD	HL,(FLAGHP) ;Encode F' register.
050B	CD2305		1752	CALL	ENCODE
050E	2ADA1F		1753	LD	HL,(FLAGLP)
0511	CD2305		1754	CALL	ENCODE
0514	32C41F		1755	LD	(UAFP),A
0517	C9		1756	RET	
			1757		;
			1758	DECODE:	
			1759		; Decode bit 7c4 of A register.
			1760		; Each bit is extended to 4 bits.
			1761		; 0 becomes 0000, 1 becomes 0001.
			1762		; The output is stored in HL, which
			1763		; is 16 bits in length. Also, after
			1764		; execution, bit 7c4 of A register are
			1765		; bit 3c0 of A before execution.
			1766		; Register AF,B,HL are destroyed.
			1767		
0518	0604		1768	LD	B,4 ;Loop 4 times.
051A	29		1769	DRL4 ADD	HL,HL ;Clear rightmost 3
			1770		;bits of HL.
051B	29		1771	ADD	HL,HL
051C	29		1772	ADD	HL,HL
051D	07		1773	RLCA	
051E	ED6A		1774	ADC	HL,HL ;The 4th bit of HL
			1775		;is determined by carry
			1776		;flag, which is the MSB
			1777		;of A register.
0520	10F8		1778	DJNZ	DRL4
0522	C9		1779	RET	
			1780		;
			1781	ENCODE:	
			1782		; Encode HL register. Each 4 bits of HL
			1783		; are encoded to 1 bit. 0000 become 0,
			1784		; 0001 become 1. The result is stored
			1785		; in bit 3c0 of A register. Also, after
			1786		; execution, bit 7c4 of A are bit 3c0
			1787		; before execution.
			1788		; Registers AF,B,HL are destroyed.
			1789		
0523	0604		1790	LD	B,4 ;Loop 4 times.
0525	29		1791	ERL4 ADD	HL,HL ;Shift HL left 4 bits.
			1792		;Bit 12 of HL will be
			1793		;shifted into carry flag.
0526	29		1794	ADD	HL,HL
0527	29		1795	ADD	HL,HL
0528	29		1796	ADD	HL,HL
0529	17		1797	RLA	
			1798		;Rotate carry flag into
					;A register.

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MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
052A 10F9      1799      DJNZ  ERL4
052C  C9       1800      RET
1801      ;
1802      ;*****
1803  SUM1:
1804      ; Calculate the sum of the data in a memory
1805      ; block. The starting and ending address
1806      ; of this block are stored in STEPBF+2 ç STEPBF+4.
1807      ; Registers AF,BC,DE,HL are destroyed.
1808
052D  CD3A05   1809      CALL  GETPTR ;Get parameters from
1810      ;step buffer.
0530  D8       1811      RET    C      ;Return if the parameters
1812      ;are illegal.
1813  SUM:
1814      ; Calculate the sum of a memory block.
1815      ; HL contains the starting address of
1816      ; this block, BC contains the length.
1817      ; The result is stored in A. Registers
1818      ; AF,BC,HL are destroyed.
1819
0531  AF       1820      XOR   A      ;Clear A.
0532  86       1821  SUMCAL  ADD   A,(HL) ;Add
0533  EDA1     1822      CPI
0535  EA3205  1823      JP    PE,SUMCAL
0538  B7       1824      OR   A      ;Clear flags.
0539  C9       1825      RET
1826      ;
1827  GETPTR:
1828      ; Get parameters from step buffer.
1829      ; Input: (STEPBF+2) and (STEPBF+3) contain
1830      ; starting address.
1831      ; (STEPBF+4) and (STEPBF+5) contain
1832      ; ending address.
1833      ; Output: HL register contains the starting
1834      ; address.
1835      ; BC register contains the length.
1836      ; Carry flay 0 -- BC positive
1837      ; 1 -- BC negative
1838      ; Destroyed reg.: AF,BC,DE,HL.
1839
053A  21B11F   1840      LD    HL,STEPBF+2
053D  5E       1841  GETP   LD    E,(HL) ;Load starting address
1842      ;into DE.
053E  23       1843      INC  HL
053F  56       1844      LD   D,(HL)
0540  23       1845      INC  HL
0541  4E       1846      LD   C,(HL)
0542  23       1847      INC  HL ;Load ending address
1848      ;into HL.
0543  66       1849      LD   H,(HL)
0544  69       1850      LD   L,C
0545  B7       1851      OR   A      ;Clear carry flag.
0546  ED52     1852  SBC   HL,DE ;Find difference.
1853      ;Carry flag is changed here.
0548  4D       1854      LD   C,L
0549  44       1855      LD   B,H
054A  03       1856      INC  BC ;Now BC contains the

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MPP-I

LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
		1857		;length.
054B	EB	1858	EX	DE,HL ;Now HL contains the
		1859		;starting address.
054C	C9	1860	RET	
		1861		;
		1862	TAPEIN:	
		1863		; Load a memory block from tape.
		1864		; Input: HL -- starting address of the block
		1865		; BC -- length of the block
		1866		; Output: Carry flag,1 -- reading error
		1867		; 0 -- no error
		1868		; Destroyed reg. -- AF,BC,DE,HL,AF',BC',DE',HL'
		1869		
054D	AF	1870	XOR	A ;Clear carry flag.
		1871		;At beginning, the reading is
		1872		;no error.
054E	08	1873	EX	AF,AF'
054F	CD5A05	1874	TLOOP	CALL GETBYTE ;Read 1 byte from tape.
0552	73	1875	LD	(HL),E ;Store it into memory.
0553	EDA1	1876	CPI	
0555	EA4F05	1877	JP	PE,TLOOP ;Loop until length
		1878		;is zero.
0558	08	1879	EX	AF,AF'
0559	C9	1880	RET	
		1881		;
		1882	GETBYTE:	
		1883		; Read one byte from tape.
		1884		; Output: E -- data read.
		1885		; Carry of F',1 -- reading error
		1886		; 0 -- no error
		1887		; Destroy reg. -- AF,DE,AF',BC',DE',HL'
		1888		; Byte format:
		1889		
		1890		; start bit bit bit bit bit bit bit bit stop
		1891		; bit 0 1 2 3 4 5 6 7 bit
		1892		
055A	CD6B05	1893	CALL	GETBIT ;Get start bit.
055D	1608	1894	LD	D,8 ;Loop 8 times.
055F	CD6B05	1895	BLOOP	CALL GETBIT ;Get one data bit.
		1896		;Result in carry flag.
		1897	RR	E ;Rotate it into E.
0562	CB1B	1898	DEC	D
0564	15	1899	JR	NZ,BLOOP
0565	20F8	1900	CALL	GETBIT ;Get stop bit.
0567	CD6B05	1901	RET	
056A	C9	1902		
		1903		;
		1904	GETBIT:	
		1905		; Read one bit from tape.
		1906		; Output: Carry of F,0 -- this bit is 0
		1907		; 1 -- this bit is 1
		1908		; Carry of F',1 -- reading error
		1909		; 0 -- no error
		1910		; Destroyed reg. -- AF,AF',BC',DE',HL'
		1911		; Bit format:
		1912		
		1913		; 0 -- 2K Hz 8 cycles + 1K Hz 2 cycles.
		1914		; 1 -- 2K Hz 4 cycles + 1K Hz 4 cycles.

MPF-I

LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
		1915		
056B	D9	1916	EXX	;Save HL,BC,DE registers
		1917		
		1918		; The tape-bit format of both 0 and 1 are
		1919		; of the same form: high freq part + low freq part.
		1920		; The difference between 0 and 1 is the
		1921		; number high freq cycles and low freq
		1922		; cycles. Thus, a high freq period may has
		1923		; two meanings:
		1924		; i) It is used to count the number of high
		1925		; freq cycles of the current tape-bit;
		1926		; ii) If a high freq period is detected
		1927		; immediately after a low freq period, then
		1928		; this period is the first cycle of next
		1929		; tape-bit and is used as a terminator of the
		1930		; last tape-bit.
		1931		
		1932		; Bit 0 of H register is used to indicate the usage
		1933		; of a high freq period. If this bit is zero, high
		1934		; freq period causes counter increment for the current
		1935		; tape-bit. If the high freq part has passed, bit 0
		1936		; of H is set and the next high freq period will be used
		1937		; as a terminator.
		1938		; L register is used to up/down count the number of periods.
		1939		; when a high freq period is read, L is increased by
		1940		; 1; when a low freq period is read, L is decreased
		1941		; by 2. (The time duration for each count is 0.5 ms.)
		1942		; At the end of a tape-bit, positive and negative L
		1943		; stand for 0 and 1 respectively.
		1944		
056C	210000	1945	LD	HL,0 ;Clear bit 0 of H,
		1946		;Set L to 0.
056F	CD8C05	1947	COUNT CALL	PERIOD ;Read one period.
0572	14	1948	INC	D ;The next 2 instructions
		1949		;check if D is zero. Carry
		1950		;flag is not affected.
0573	15	1951	DEC	D
0574	2011	1952	JR	NZ,TERR ;If D is not zero, jump
		1953		;to error routine TERR.
		1954		;(Because the period is too
		1955		;much longer than that of 1K Hz.)
0576	3806	1956	JR	C,SHORTP ;If the period is short
		1957		;(2K Hz), jump to SHORTP.
0578	2D	1958	DEC	L ;The period is 1K Hz,
		1959		;decrease L by 2. And set
		1960		;bit 0 of H to indicate this
		1961		;tape-bit has passed high freq
		1962		;part and reaches its low freq part.
0579	2D	1963	DEC	L
057A	CBC4	1964	SET	0,H
057C	18F1	1965	JR	COUNT
057E	2C	1966	SHORTP INC	L ;The period is 2 K Hz,
		1967		;increase L by 1.
057F	CB44	1968	BIT	0,H ;If the tape-bit has passed
		1969		;its high freq part, high frequency
		1970		;means this bit is all over and
		1971		;next bit has started.
0581	28EC	1972	JR	Z,COUNT

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MPF I
LOC  OBJ CODE M STMT SOURCE STATEMENT
0583  CB15      1973                ;L = (# of 2K period) - 2*(# of 1K period)
          1974                L
          1975                RL
          1976                ; 0 --- NCarry (L positive)
          1977                ; 1 --- Carry (L negative)
          1978                ;The positive or negative sign of
          1979                ;L corresponds to the tape-bit data.
          1980                ;'RL L' will shift the sign bit of
          1981                ;L into carry flag. After this
          1982                ;instruction, the carry flag
          1983                ;contains the tape-bit.
0585  D9        1983                EXX      ;Restore BC',DE',HL'
0586  C9        1984                RET
0587  O8        1985      TERR      EX      AF,AF'
0588  37        1986                SCF      ;Set carry flag of F' to indicate error.
0589  O8        1987                EX      AF,AF'
058A  D9        1988                EXX
058B  C9        1989                RET
          1990                ;
          1991      PERIOD:
          1992                ; Wait the tape to pass one period.
          1993                ; The time duration is stored in DE. The
          1994                ; unit is loop count. Typical value for
          1995                ; 2K Hz is 28, for 1K Hz is 56.
          1996                ; Use (56+28)/2 as threshold. The returned
          1997                ; result is in carry flag. (1K -- NC, 2K -- C)
          1998                ; Register AF and DE are destroyed.
          1999
058C  110000    2000                LD      DE,0
058F  DB00      2001      LOOPH     IN      A,(KIN) ;Bit 7 of port A is Tapein.
0591  13        2002                INC     DE
0592  17        2003                RLA
0593  38FA      2004                JR      C,LOOPH ;Loop until input goes low.
0595  3EFF      2005                LD      A,11111111B ;Echo the tape input to
          2006                ;speaker on MPF-I.
0597  D302      2007                OUT     (DIGIT),A
0599  DB00      2008      LOOPL     IN      A,(KIN)
059B  13        2009                INC     DE
059C  17        2010                RLA
059D  30FA      2011                JR      NC,LOOPL ;Loop until input goes high.
059F  3E7F      2012                LD      A,01111111B ;Echo the tape input to
          2013                ;speaker on MPF-I.
05A1  D302      2014                OUT     (DIGIT),A
05A3  7B        2015                LD      A,E      ;Compare the result with
          2016                ;the threshold.
05A4  FE2A      2017                CP      MPERIOD
05A6  C9        2018                RET
          2019                ;
          2020                ;*****
          2021      TAPEOUT:
          2022                ; Output a memory block to tape.
          2023                ; Input: HL -- starting address of the block
          2024                ;       BC -- length of the block
          2025                ; Destroyed reg. -- AF,BC,DE,HL,BC',DE',HL'
          2026
05A7  5E        2027                LD      E,(HL) ;Get the data.
05A8  CDB105    2028                CALL   OUTBYTE ;Output to tape.
05AB  EDA1      2029                CPI
05AD  EAA705    2030                JP      PE,TAPEOUT ;Loop until finished.

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                                MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
05B0  C9          2031          RET
                2032          ;
                2033  OUTBYTE:
                2034          ; Output one byte to tape.  For tape-byte
                2035          ; format, see comments on GETBYTE.
                2036          ; Input: E -- data
                2037          ; Destroyed reg. -- AF,DE,BC',DE',HL'
                2038
05B1  1608       2039          LD      D,8      ;Loop 8 times.
05B3  B7         2040          OR      A          ;Clear carry flag.
05B4  CDC405     2041          CALL   OUTBIT  ;Output start bit.
05B7  CB1B      2042  OLOOP   RR      E          ;Rotate data into carry
05B9  CDC405     2043          CALL   OUTBIT  ;Output the carry
05BC  15         2044          DEC     D
05BD  20F8      2045          JR      NZ,OLOOP
05BF  37         2046          SCF     ;Set carry flag.
05C0  CDC405     2047          CALL   OUTBIT  ;Output stop bit
05C3  C9         2048          RET
                2049          ;
                2050  OUTBIT:
                2051          ; Output one bit to tape.
                2052          ; Input: data in carry flag.
                2053          ; Destroyed reg. -- AF,BC',DE',HL'
05C4  D9         2054          EXX     ;Save BC,DE,HL.
05C5  2600       2055          LD      H,0
05C7  3809       2056          JR      C,OUT1  ;If data=1, output 1.
                2057  OUT0:   ;2K 8 cycles, 1K 2 cycles.
05C9  2E08       2058          LD      L,ZERO 2K
05CB  CDE205     2059          CALL   TONE2K
05CE  2E02       2060          LD      L,ZERO 1K
05D0  1807       2061          JR      BITEND
                2062          ;
                2063  OUT1:   ;2K 4 cycles, 1K 4 cycles.
05D2  2E04       2064          LD      L,ONE 2K
05D4  CDE205     2065          CALL   TONE2K
05D7  2E04       2066          LD      L,ONE 1K
05D9  CDDE05    2067  BITEND  CALL   TONE1K
05DC  D9         2068          EXX     ;Restore registers.
05DD  C9         2069          RET
                2070          ;
                2071          ;*****
                2072          ;
                2073          ;          UTILITY SUBROUTINE
                2074          ;
                2075          ;*****
                2076          ;
                2077          ; Function: Generate square wave to the MIC & speaker
                2078          ;          on MPF - - 1
                2079          ; Input : C -- period = 2*(44+13*C) clock states.
                2080          ;          HL -- number of periods.
                2081          ; Output: none.
                2082          ; Destroyed reg.: AF, B(C), DE, HL.
                2083          ; Call: none.
                2084
                2085  TONE1K:
05DE  0E41       2086          LD      C,F1KHZ
05E0  1802       2087          JR      TONE
                2088  TONE2K:

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                                MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
05E2  OE1F      2089          LD      C,F2KHZ
                                2090 TONE:          ;Half period: 44+13*C states
05E4  29        2091          ADD     HL,HL          ;Double for half-cycle count
05E5  110100     2092          LD      DE,1
05E8  3EFF       2093          LD      A,OFFH
05EA  D302       2094 SQWAVE  OUT     (DIGIT),A ;Bit-7 tapeout
05EC  41         2095          LD      B,C
05ED  10FE       2096          DJNZ   $              ;Half period delay
05EF  EE80       2097          XOR    80H            ;Toggle output
05F1  ED52       2098          SBC   HL,DE          ;Decrement one count
05F3  20F5       2099          JR     NZ,SQWAVE
05F5  C9         2100          RET
                                2101 ;
                                2102 ;*****
                                2103 ; Function: check if a memory address is in RAM.
                                2104 ; Input: HL -- address to be check.
                                2105 ; Output: Zero flag -- 0, ROM or nonexistant;
                                2106 ;                               1, RAM.
                                2107 ; Destroyed reg.: AF.
                                2108 ; Call: none
                                2109 ;
                                2110 RAMCHK:
05F6  7E         2111          LD      A,(HL)
05F7  2F         2112          CPL
05F8  77         2113          LD      (HL),A
05F9  7E         2114          LD      A,(HL)
05FA  2F         2115          CPL
05FB  77         2116          LD      (HL),A
05FC  BE         2117          CP     (HL)
05FD  C9         2118          RET
                                2119 ;
                                2120 ;*****
                                2121 ; Function: Scan the keyboard and display. Loop until
                                2122 ; a key is detected. If the some key is already
                                2123 ; pressed when this routine starts execution,
                                2124 ; return when next key is entered.
                                2125 ; Input: IX points to the buffer contains display patterns.
                                2126 ; 6 LEDs require 6 byte data. (IX) contains the
                                2127 ; pattern for rightmost LED, (IX+5) contains the
                                2128 ; pattern for leftmost LED.
                                2129 ; Output: internal code of the key pressed.
                                2130 ; Destroyed reg. : AF, B, HL, AF', BC', DE'.
                                2131 ; All other registers except IY are also
                                2132 ; changed during execution, but they are
                                2133 ; restored before return.
                                2134 ; Call: SCAN1
                                2135 ;
                                2136 SCAN:
05FE  DDE5       2137          PUSH   IX              ;Save IX.
0600  21E61F     2138          LD     HL,TEST
0603  CB7E       2139          BIT   7,(HL)          ;This bit is sert if the use
                                2140 ;has entered illegal key. The
                                2141 ;display will be disabled as
                                2142 ;a warning to the user. This
                                2143 ;is done by replacing the display
                                2144 ;buffer pointer IX by BLANK.
0605  2804       2145          JR     Z,SCPRE
0607  DD21A507   2146          LD     IX,BLANK

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                                MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
                                2147
                                2148 ; Wait until all keys are released for 40 ms.
                                2149 ; (The execution time of SCAN1 is 10 ms,
                                2150 ; 40 = 10 * 4.)
                                2151
060B 0604      2152 SCPRE LD      B,4
060D CD2406    2153 SCNXX CALL   SCAN1
0610 30F9      2154 JR      NC,SCPRE ;If any key is pressed, re-load
                                ;the debounce counter B by 4.
                                2155
0612 10F9      2156 DJNZ    SCNX
0614 CBBE      2157 RES     7,(HL) ;Clear error-flag.
0616 DDE1      2158 POP     IX    ;Restore original IX.
                                2159
                                2160 ; Loop until any key is pressed.
                                2161
0618 CD2406    2162 SCLOOP CALL  SCAN1
061B 38FB      2163 JR      C,SCLOOP
                                2164
                                2165 ; Convert the key-position-code returned by SCAN1 to
                                2166 ; key-internal-code. This is done by table-lookup.
                                2167 ; The table used is KEYPAB.
                                2168
061D 217B07    2169 KEYMAP LD     HL,KEYTAB
0620 85         2170 ADD     A,L
0621 6F         2171 LD     L,A
0622 7E         2172 LD     A,(HL)
0623 C9         2173 RET
                                2174 ;
                                2175 ;*****
                                2176 ; Function: Scan keyboard and display one cycle.
                                2177 ; Total execution time is about 10 ms (exactly
                                2178 ; 9.95 ms, 17812 clock states @ 1.79 MHz).
                                2179 ; Input: Same as SCAN.
                                2180 ; Output: i) no key during one scan
                                2181 ; Carry flag -- 1
                                2182 ; ii) key pressed during one scan
                                2183 ; Carry flag -- 0,
                                2184 ; A -- position code of the key pressed.
                                2185 ; If more than one key is pressed, A
                                2186 ; contains the largest position-code.
                                2187 ; (This key is the last key scanned.)
                                2188 ; Destroyed reg: AF, AF', BC', DE'. (see comments on SCAN)
                                2189 ; Call: none.
                                2190
                                2191 SCAN1:
                                2192 ;In hardware, the display and keyboard are
                                2193 ;arranged as a 6 by 6 matrix. Each cloumn
                                2194 ;corresponds to one LED and six key buttons.
                                2195 ;In normal operation, at most one column is
                                2196 ;active. The pattern of the active LED is the
                                2197 ;data output on port C of 8255 I. The data input
                                2198 ;from bit 0c5 of port A are the status of key
                                2199 ;buttons in the active column. All signals on
                                2200 ;I/O port are active low.
                                2201
0624 37         2202 SCF
0625 08         2203 EX     AF,AF' ;Set carry flag.
0626 D9         2204 EXX

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MPF I

LOC OBJ CODE M STMT SOURCE STATEMENT

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2205
2206 ;Carry flag of F' is used to return the status of
2207 ;the keyboard. If any key is pressed during one
2208 ;scan, the flag is reset; otherwise, it is set.
2209 ;Initially, this flag is set. A' register is used
2210 ;to store the position-code of the key pressed.
2211 ;In this routine, 36 key positions are checked one
2212 ;by one. C register contains the code of the key
2213 ;being checked. The value of C is 0 at the beginning,
2214 ;and is increased by 1 after each check. So the code
2215 ;ranges from 0 to 23H (total 36 positions). On each
2216 ;check, if the input bit is 0 (key pressed), C register
2217 ;is copied into A'. The carry flag of F' is set also.
2218 ;When some key is detected, the key positions after
2219 ;this key will still be checked. So if more than
2220 ;one key are pressed during one scan, the code of the
2221 ;last one will be returned.
2222
0627 0E00 2223 LD C,0 ;Initial position code
0629 1EC1 2224 LD E,11000001B ;Scan from rightmost digit.
062B 2606 2225 LD H,6
2226 ;to the active column.
062D 7B 2227 KCOL LD A,E
062E D302 2228 OUT (DIGIT),A ;Activate one column.
0630 DD7E00 2229 LD A,(IX)
0633 D301 2230 OUT (SEG7),A
0635 06C9 2231 LD B,COLDEL
0637 10FE 2232 DJNZ $ ;Delay 1.5 ms per digit.
0639 AF 2233 XOR A ;Deactivate all display segments
063A D301 2234 OUT (SEG7),A
063C 7B 2235 LD A,E
063D 2F 2236 CPL
063E F6C0 2237 OR 11000000B
0640 D302 2238 OUT (DIGIT),A
0642 0606 2239 LD B,6 ;Each column has 6 keys.
0644 DB00 2240 IN A,(KIN) ;Now, bit 0c5 of A contain
2241 ;the status of the 6 keys
2242 ;in the active column.
0646 57 2243 ID D,A ;Store A into D.
0647 CB1A 2244 KROW RR D ;Rotate D 1 bit right, bit 0
2245 ; of D will be rotated into
2246 ;carry flag.
0649 3802 2247 JR C,NOKEY ;Skip next 2 instructions
2248 ;if the key is not pressed.
2249 ;The next 2 instructions
2250 ;store the current position-code
2251 ;into A' and reset carry flag
2252 ;of F' register.
064B 79 2253 LD A,C ;Key-in, get key position.
064C 08 2254 EX AF,AF' ;Save A & Carry in AF'.
064D 0C 2255 NOKEY INC C ;Increase current key-code by 1.
064E 10F7 2256 DJNZ KROW ;Loop until 6 keys in the
2257 ;active columns are all checked.
0650 DD23 2258 INC IX
0652 7B 2259 LD A,E
0653 E63F 2260 AND 00111111B
0655 CB07 2261 RLC A
0657 F6C0 2262 OR 11000000B

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                                MPF-I
LOC   OBJ CODE M STMT SOURCE STATEMENT
0659  5F           2263          LD      E,A
065A  25           2264          DEC     H
065B  20D0         2265          JR      NZ,KCOL
065D  11FAFF       2266          LD      DE,-6
0660  DD19         2267          ADD     IX,DE      ;Get original IX.
0662  D9           2268          EXX
0663  08           2269          EX      AF,AF'
0664  C9           2270          RET
                                2271 ;
                                2272 ;*****
                                2273 ; Function: Convert the 2 byte data stored in DE to
                                2274 ; 7-segment display format. The output is stored
                                2275 ; in the address field of DISPBF (display buffer),
                                2276 ; most significant digit in DISPBF+5.
                                2277 ; This routine is usually used by monitor only.
                                2278 ; Destroyed reg: AF, HL.
                                2279 ; Call: HEX7SG
                                2280
                                2281 ADDRDP:
0665  21B81F        2282          LD      HL,DISPBF+2
0668  7B           2283          LD      A,E
0669  CD7806        2284          CALL   HEX7SG
066C  7A           2285          LD      A,D
066D  CD7806        2286          CALL   HEX7SG
0670  C9           2287          RET
                                2288 ;
                                2289 ;*****
                                2290 ; Function: Convert the data stored in A to 7-segment
                                2291 ; display format. 1 byte is converted to 2
                                2292 ; digits. The result is stored in the data
                                2293 ; field of display buffer (DISPBF).
                                2294 ; This routine is usually used by monitor only.
                                2295 ; Destroyed reg: AF, HL.
                                2296 ; Call: HEX7SG
                                2297
                                2298 DATADP:
0671  21B61F        2299          LD      HL,DISPBF
0674  CD7806        2300          CALL   HEX7SG
0677  C9           2301          RET
                                2302 ;
                                2303 ;*****
                                2304 ; Function: Convert binary data to 7-segment display
                                2305 ; format.
                                2306 ; Input: 1 byte in A register.
                                2307 ; HL points to the result buffer.
                                2308 ; Output: Pattern for 2 digits. Low order digit in (HL),
                                2309 ; high order digit in (HL+1).
                                2310 ; HL becomes HL+2.
                                2311 ; Destory reg: AF, HL.
                                2312 ; Call: HEX7
                                2313
                                2314 HEX7SG:
0678  F5           2315          PUSH   AF
0679  CD8906        2316          CALL   HEX7
067C  77           2317          LD      (HL),A
067D  23           2318          INC     HL
067E  F1           2319          POP    AF
067F  0F           2320          RRCA

```

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                                MPF-I
LOC  OBJ CODE M STMT SOURCE STATEMENT
0680  OF          2321          RRCA
0681  OF          2322          RRCA
0682  OF          2323          RRCA
0683  CD8906     2324          CALL    HEX7
0686  77          2325          LD      (HL),A
0687  23          2326          INC    HL
0688  C9          2327          RET
                2328          ;
                2329          ;*****
                2330          ; Function: Convert binary data to 7-segment display
                2331          ;          format.
                2332          ; Input: A -- LSB 4 bits contains the binary data
                2333          ; Output: A -- display pattern for 1 digit.
                2334          ; Destroyed reg: AF
                2335          ; Call: none
                2336
                2337  HEX7:
0689  E5          2338          PUSH   HL
068A  21F007     2339          LD     HL,SEGTAB
068D  E60F      2340          AND   OFH
068F  85          2341          ADD   A,L
0690  6F          2342          LD   L,A
0691  7E          2343          LD   A,(HL)
0692  E1          2344          POP  HL
0693  C9          2345          RET
                2346          ;
                2347          ;
                2348          ;*****
                2349          ; Function: RAM 1800-1FFF self-check.
                2350          ; Input: none
                2351          ; Output: none
                2352          ; Destroyed reg: AF, BC, HL
                2353          ; Call: RAMCHK
                2354
                2355  RAMTEST:
0694  210018     2356          LD     HL,1800H
0697  010008     2357          LD     BC,800H
069A  CDF605     2358  RAMT  CALL  RAMCHK
069D  2801      2359          JR   Z,TNEXT
069F  76          2360          HALT          ;If error.
06A0  EDA1      2361  TNEXT CPI
06A2  EA9A06     2362          JP   PE,RAMT
06A5  C7          2363          RST   0          ;Display 'uPF--1'.
                2364          ;
                2365          ;*****
                2366          ;Monitor ROM self-check. Add the data of address
                2367          ;0000 c 0800. If the sum equals to 0. Reset the monitor.
                2368          ;and display 'uPF--1'. If the sum is not 0, which
                2369          ;indicates error, HALT.
                2370          ;Input: none.
                2371          ;Output: none.
                2372          ;Destroyed registers: AF, BC, HL.
                2373          ;Call: SUM.
                2374
                2375  ROMTEST:
06A6  210000     2376          LD     HL,0
06A9  010008     2377          LD     BC,800H
06AC  CD3105     2378          CALL  SUM

```

MPP-I

LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT
06AF	2801		2379	JR	Z,SUMOK
06B1	76		2380	HALT	;If error.
06B2	C7		2381	SUMOK RST	0 ;Display 'uPF--1'.
06B3	32E51F		2382	INI3 LD	(POWERUP);A ;Load power-code into
			2383		;(POWERUP). The monitor
			2384		;uses the location to decide
			2385		;whether a reset signal is
			2386		;on power-up.
06B6	3E55		2387	LD	A,55H
06B8	32F01F		2388	LD	(BEEPSET),A
06BB	3E44		2389	LD	A,44H
06BD	32F11F		2390	LD	(FBEEP),A ;Beep frequency when key is
			2391		;pressed.
06C0	21F21F		2392	LD	HL,TBEEP
06C3	362F		2393	LD	(HL),2FH ;Time duration of beep when
06C5	23		2394	INC	HL
06C6	3600		2395	LD	(HL),0
			2396		;key is pressed.
06C8	C3D803		2397	JP	INI4
			2398		
06CB	F5		2399	BEEP PUSH	AF
06CC	21F11F		2400	LD	HL,FBEEP
06CF	4E		2401	LD	C,(HL)
06D0	2AF21F		2402	LD	HL,(TBEEP)
06D3	3AF01F		2403	LD	A,(BEEPSET)
06D6	FE55		2404	CP	55H
06D8	2003		2405	JR	NZ,NOTONE ;There is no beep sound when
			2406		;the key is pressed if data
			2407		;of (BEEPSET) is not 55H
06DA	CDE405		2408	CALL	TONE
			2409	NOTONE:	
06DD	F1		2410	POP	AF
06DE	C3E900		2411	JP	KEYEXEC ;After a key is detected,determine
			2412		;what action should the monitor take.
			2413		;KEYEXEC uses the next 3 factors
			2414		;to get the entry point of proper
			2415		;service routine :key-code, STATE
			2416		;and STMINOR (Minor-State).
			2417		; Below are the branch tables for each key and
			2418		; state. The first entry of each table is
			2419		; a base address, other entries are the offset to
			2420		; this address. Offset is only one byte long,
			2421		; which is much shorter than the 2-byte address.
			2422		; This can save the monitor code space.
			2423		
0737			2424	KSUBFUN ORG	0737H
0737	1B01		2425	DEFW	KINC
0739	00		2426	DEFB	-KINC+KINC
073A	05		2427	DEFB	-KINC+KDEC
073B	0A		2428	DEFB	-KINC+KGO
073C	0F		2429	DEFB	-KINC+KSTEP
073D	1A		2430	DEFB	-KINC+KDATA
073E	2C		2431	DEFB	-KINC+KSBR
073F	42		2432	DEFB	-KINC+KINS
0740	7B		2433	DEFB	-KINC+KDEL
0741	C201		2434	KFUN DEFW	KPC
0743	00		2435	DEFB	-KPC+KPC
0744	1C		2436	DEFB	-KPC+KADDR

MPP-I

LOC OBJ CODE M STMT SOURCE STATEMENT

0745	0A		2437		DEFB	-KPC+KCBR
0746	14		2438		DEFB	-KPC+KREG
0747	20		2439		DEFB	-KPC+KMV
0748	20		2440		DEFB	-KPC+KRL.
0749	26		2441		DEFB	-KPC+KWT
074A	26		2442		DEFB	-KPC+KRT
074B	EC01		2443	HTAB	DEFW	HF IX
074D	00		2444		DEFB	-HF IX+HF IX
074E	16		2445		DEFB	-HF IX+HAD
074F	03		2446		DEFB	-HF IX+HDA
0750	26		2447		DEFB	-HF IX+HRGF IX
0751	34		2448		DEFB	-HF IX+HMV
0752	34		2449		DEFB	-HF IX+HRL
0753	34		2450		DEFB	-HF IX+HWT
0754	34		2451		DEFB	-HF IX+HRT
0755	26		2452		DEFB	-HF IX+HRGAD
0756	44		2453		DEFB	-HF IX+HRGDA
0757	3D02		2454	ITAB	DEFW	IF IX
0759	00		2455		DEFB	-IF IX+IF IX
075A	03		2456		DEFB	-IF IX+IAD
075B	03		2457		DEFB	-IF IX+IDA
075C	00		2458		DEFB	-IF IX+IRGF IX
075D	0E		2459		DEFB	-IF IX+IMV
075E	0E		2460		DEFB	-IF IX+IRL
075F	0E		2461		DEFB	-IF IX+IWT
0760	0E		2462		DEFB	-IF IX+IRT
0761	1F		2463		DEFB	-IF IX+IRGAD
0762	1F		2464		DEFB	-IF IX+IRGDA
0763	6B02		2465	DTAB	DEFW	DF IX
0765	00		2466		DEFB	-DF IX+DF IX
0766	03		2467		DEFB	-DF IX+DAD
0767	03		2468		DEFB	-DF IX+DDA
0768	00		2469		DEFB	-DF IX+DRGF IX
0769	0E		2470		DEFB	-DF IX+DMV
076A	0E		2471		DEFB	-DF IX+DRL
076B	0E		2472		DEFB	-DF IX+DWT
076C	0E		2473		DEFB	-DF IX+DRT
076D	1F		2474		DEFB	-DF IX+DRGAD
076E	1F		2475		DEFB	-DF IX+DRGDA
076F	9902		2476	GTAB	DEFW	GF IX
0771	00		2477		DEFB	-GF IX+GF IX
0772	03		2478		DEFB	-GF IX+GAD
0773	03		2479		DEFB	-GF IX+GDA
0774	00		2480		DEFB	-GF IX+GRGF IX
0775	4B		2481		DEFB	-GF IX+GMV
0776	6D		2482		DEFB	-GF IX+GRL
0777	8B		2483		DEFB	-GF IX+GWT
0778	C1		2484		DEFB	-GF IX+GRT
0779	00		2485		DEFB	-GF IX+GRGAD
077A	00		2486		DEFB	-GF IX+GRGDA
			2487			
			2488			; Key-position-code to key-internal-code conversion table.
			2489			
			2490	KEYTAB:		
077B	03		2491	K0	DEFB	03H ;HEX 3
077C	07		2492	K1	DEFB	07H ;HEX 7
077D	0B		2493	K2	DEFB	0BH ;HEX B
077E	0F		2494	K3	DEFB	0FH ;HEX F

MPF-I

LOC	OBJ	CODE	M	STMT	SOURCE	STATEMENT
077F	20			2495	K4	DEFB 20H ;NOT USED
0780	21			2496	K5	DEFB 21H ;NOT USED
0781	02			2497	K6	DEFB 02H ;HEX 2
0782	06			2498	K7	DEFB 06H ;HEX 6
0783	0A			2499	K8	DEFB 0AH ;HEX A
0784	0E			2500	K9	DEFB 0EH ;HEX E
0785	22			2501	K0A	DEFB 22H ;NOT USED
0786	23			2502	K0B	DEFB 23H ;NOT USED
0787	01			2503	K0C	DEFB 01H ;HEX 1
0788	05			2504	K0D	DEFB 05H ;HEX 5
0789	09			2505	K0E	DEFB 09H ;HEX 9
078A	0D			2506	K0F	DEFB 0DH ;HEX D
078B	13			2507	K10	DEFB 13H ;STEP
078C	1F			2508	K11	DEFB 1FH ;TAPERD
078D	00			2509	K12	DEFB 00H ;HEX 0
078E	04			2510	K13	DEFB 04H ;HEX 4
078F	08			2511	K14	DEFB 08H ;HEX 8
0790	0C			2512	K15	DEFB 0CH ;HEX C
0791	12			2513	K16	DEFB 12H ;GO
0792	1E			2514	K17	DEFB 1EH ;TAPEWR
0793	1A			2515	K18	DEFB 1AH ;CBR
0794	18			2516	K19	DEFB 18H ;PC
0795	1B			2517	K1A	DEFB 1BH ;REG
0796	19			2518	K1B	DEFB 19H ;ADDR
0797	17			2519	K1C	DEFB 17H ;DEL
0798	1D			2520	K1D	DEFB 1DH ;RELA
0799	15			2521	K1E	DEFB 15H ;SBR
079A	11			2522	K1F	DEFB 11H ;-
079B	14			2523	K20	DEFB 14H ;DATA
079C	10			2524	K21	DEFB 10H ;+
079D	16			2525	K22	DEFB 16H ;INS
079E	1C			2526	K23	DEFB 1CH ;MOVE
				2527		;
				2528		;
				2529		;
				2530		;
079F	30			2531	MPF_I	DEFB 030H ;'1'
07A0	02			2532		DEFB 002H ;'-'
07A1	02			2533		DEFB 002H ;'-'
07A2	0F			2534		DEFB 0FH ;'F'
07A3	1F			2535		DEFB 1FH ;'P'
07A4	A1			2536		DEFB 0A1H ;'u'
07A5	00			2537	BLANK	DEFB 0
07A6	00			2538		DEFB 0
07A7	00			2539		DEFB 0
07A8	00			2540		DEFB 0
07A9	00			2541	ERR_	DEFB 0
07AA	00			2542		DEFB 0
07AB	03			2543		DEFB 3 ;'R'
07AC	03			2544		DEFB 3 ;'R'
07AD	8F			2545		DEFB 8FH ;'E'
07AE	02			2546		DEFB 2 ;'-'
07AF	1F			2547	SYS_SP	DEFB 1FH ;'P'
07B0	AE			2548		DEFB 0AEH ;'S'
07B1	02			2549		DEFB 02H ;'-'
07B2	AE			2550		DEFB 0AEH ;'S'
07B3	B6			2551		DEFB 0B6H ;'Y'
07B4	AE			2552		DEFB 0AEH ;'S'

MPF-I						
LOC	OBJ CODE	M	STMT	SOURCE	STATEMENT	
07B5	1F		2553	ERR_SP	DEFB	1FH ;'P'
07B6	AE		2554		DEFB	0AEH ;'S'
07B7	02		2555		DEFB	02 ;'-'
07B8	03		2556		DEFB	03 ;'R'
07B9	03		2557		DEFB	03 ;'R'
07BA	8F		2558		DEFB	8FH ;'E'
07BB	00		2559		DEFB	0
07BC	AE		2560	STEPTAB	DEFB	0AEH ;'S'
07BD	8F		2561		DEFB	08FH ;'E'
07BE	B3		2562		DEFB	0B3H ;'D'
07BF	00		2563		DEFB	0
07C0	AE		2564		DEFB	0AEH ;'S'
07C1	B3		2565		DEFB	0B3H ;'D'
07C2	00		2566		DEFB	0
07C3	00		2567		DEFB	0
07C4	0F		2568		DEFB	0FH ;'F'
07C5	AE		2569		DEFB	0AEH ;'S'
07C6	8F		2570		DEFB	08FH ;'E'
07C7	00		2571		DEFB	0
07C8	0F		2572		DEFB	0FH ;'F'
07C9	00		2573		DEFB	0
07CA	00		2574	REG_	DEFB	0
07CB	00		2575		DEFB	0
07CC	02		2576		DEFB	02H ;'-'
07CD	BE		2577		DEFB	0BEH ;'G'
07CE	8F		2578		DEFB	08FH ;'E'
07CF	03		2579		DEFB	03H ;'R'
07D0	0F3F		2580	RGTAB	DEFW	3F0FH ;'AF'
07D2	SDA7		2581		DEFW	0A78DH ;'BC'
07D4	8FB3		2582		DEFW	0B38FH ;'DE'
07D6	8537		2583		DEFW	3785H ;'HL'
07D8	4F3F		2584		DEFW	3F4FH ;'AF.'
07DA	CDA7		2585		DEFW	0A7CDH ;'BC.'
07DC	CFB3		2586		DEFW	0B3CFH ;'DE.'
07DE	C537		2587		DEFW	37C5H ;'HL.'
07E0	0730		2588		DEFW	3007H ;'IX'
07E2	B630		2589		DEFW	30B6H ;'IY'
07E4	1FAE		2590		DEFW	0AE1FH ;'SP'
07E6	0F30		2591		DEFW	300FH ;'IP'
07E8	370F		2592		DEFW	0F37H ;'FH'
07EA	850F		2593		DEFW	0F85H ;'FL'
07EC	770F		2594		DEFW	0F77H ;'FH.'
07EE	C50F		2595		DEFW	0FC5H ;'FL.'
07F0	BD		2596	SEGTAB	DEFB	0BDH ;'0'
07F1	30		2597		DEFB	30H ;'1'
07F2	9B		2598		DEFB	09BH ;'2'
07F3	BA		2599		DEFB	0BAH ;'3'
07F4	36		2600		DEFB	36H ;'4'
07F5	AE		2601		DEFB	0AEH ;'5'
07F6	AF		2602		DEFB	0AFH ;'6'
07F7	38		2603		DEFB	38H ;'7'
07F8	BF		2604		DEFB	0BFH ;'8'
07F9	BE		2605		DEFB	0BEH ;'9'
07FA	3F		2606		DEFB	3FH ;'A'
07FB	A7		2607		DEFB	0A7H ;'B'
07FC	8D		2608		DEFB	08DH ;'C'
07FD	B3		2609		DEFB	0B3H ;'D'
07FE	8F		2610		DEFB	08FH ;'E'

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LOC	OBJ CODE M	STMT	SOURCE	STATEMENT
07FF	OF	2611	DEFB	OFH ; 'F'
		2612	;	
		2613	;	*****
		2614	;	SYSTEM RAM AREA:
1F9F		2615	USERSTK	ORG 1F9FH
1F9F		2616	DEFS	16
1FAF		2617	SYSSTK:	ORG 1FAFH
1FAF		2618	STEPBF	DEFS 7
1FB6		2619	DISPBF	DEFS 6
		2620	REGBF:	
1FBC		2621	USERAF	DEFS 2
1FBE		2622	USERBC	DEFS 2
1FC0		2623	USERDE	DEFS 2
1FC2		2624	USERHL	DEFS 2
1FC4		2625	UAFP	DEFS 2
1FC6		2626	UBCP	DEFS 2
1FC8		2627	UDEP	DEFS 2
1FCA		2628	UHLP	DEFS 2
1FCC		2629	USERIX	DEFS 2
1FCE		2630	USERIY	DEFS 2
1FD0		2631	USERSP	DEFS 2
1FD2		2632	USERIF	DEFS 2
1FD4		2633	FLAGH	DEFS 2
1FD6		2634	FLAGL	DEFS 2
1FD8		2635	FLAGHP	DEFS 2
1FDA		2636	FLAGLP	DEFS 2
1FDC		2637	USERPC	DEFS 2
		2638	;	
1FDE		2639	ADSAVE	DEFS 2 ;Contains the address being
		2640		;displayed now.
1FE0		2641	BRAD	DEFS 2 ;Break point address
1FE2		2642	BRDA	DEFS 1 ;Data of break point address
1FE3		2643	STMINOR	DEFS 1 ;Minor state
1FE4		2644	STATE	DEFS 1 ;State
1FE5		2645	POWERUP	DEFS 1 ;Power-up initialization
1FE6		2646	TEST	DEFS 1 ;Flag, bit 0 -- set when function
		2647		; or subfunction key is hit.
		2648		; bit 7 -- set when illegal key
		2649		; is entered.
1FE7		2650	ATEMP	DEFS 1 ;Temporary storage
1FE8		2651	HLTEMP	DEFS 2 ;Temporary storage
1FEA		2652	TEMP	DEFS 4 ;See comments on routine GDA.
1FEE		2653	IM1AD	DEFS 2 ;Contains the address of Opcode 'FF'
		2654		;service routine. (RST 38H, mode
		2655		;1 interrupt, etc.)
1FF0		2656	BEEPSET	DEFS 1 ;Default value is 55H
1FF1		2657	FBEEP	DEFS 1 ;Beep frequency
1FF2		2658	TBEEP	DEFS 2 ;Time duration of beep
		2659		END

CROSS REFERENCE
 SYMBOL VAL M DEFN REFS

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ADDRDP	0665	2281	1262	1462	1523	1636														
ADSAVE	1FDE	2639	283	596	618	681	699	732	745	793	822	839								
			914	918	969	973	1077	1176	1458	1633										
ATEMP	1FE7	2650	221	238	274	280														
BEEP	06CB	2399	384																	
BEEPSE	1FF0	2656	2388	2403																
BITEND	05D9	2067	2061																	
BLANK	07A5	2537	1349	2146																
BLOOP	055F	1895	1899																	
BR1	0115	514	525	535	545															
BRAD	1FE0	2641	229	364	602	1024	1386	1474												
BRANCH	03B0	1301	431	455	515															
BRDA	1FE2	2642	230	362	1477															
BRRSTO	00D4	362	351																	
BRTEST	0421	1470																		
CLRBR	03DE	1378	742																	
COLDEL	00C9	27	2231																	
CONT28	003E	217	163																	
COUNT	056F	1947	1965	1972																
DAD	026E	968	2467																	
DATADP	0671	2298	1467																	
DDA	026E	969	2468																	
DECODE	0518	1758	1733	1735	1738	1740														
DFIX	026B	963	2465	2466	2467	2468	2469	2470	2471	2472	2473									
			2474	2475																
DIGIT	0002	16	115	237	279	1091	2007	2014	2094	2230	2238									
DISPBF	1FB6	2619	348	441	858	1447	1454	1483	1527	1535	1642	1673								
			2282	2299																
DMV	0279	981	2470																	
DOMV	0187	672	724																	
DRGAD	028A	995	2474																	
DRGDA	028A	996	2475																	
DRGFIX	026B	964	2469																	
DRGNA	0295	1006	1004																	
DRL	0279	980	2471																	
DRL4	051A	1769	1778																	
DRT	0279	978	2473																	
DSTEP	0286	992	989																	
DTAB	0763	2465	534																	
DWT	0279	979	2472																	
EIDI	02B2	1048	1046																	
ENCODE	0523	1781	1746	1748	1752	1754														
ENDFUN	031C	1175	1135	1141	1219															
ENDTAP	034D	1218	1298																	
ERL4	0525	1791	1799																	
ERROR	0353	1221	1119	1167	1189	1285	1288	1296												
ERR	07A9	2541	1221																	
ERR_SP	07B5	2553	329																	
F1KHZ	0041	29	2086																	
F2KHZ	001F	31	2089																	
FBEEP	1FF1	2657	2390	2400																
FCONV	04C4	1687	756	1655																
FCONV1	04DA	1732																		
FCONV2	04F9	1743	1731																	
FILEDP	038A	1265	1266																	
FLAGH	1FD4	2633	1734	1743																
FLAGHP	1FD8	2635	1739	1751																
FLAGL	1FD6	2634	1736	1747																

CROSS REFERENCE
 SYMBOL VAL M DEFN REFS

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FLAGLP	1FDA	2636	1741	1753																		
FLAGX	04D6	1722	1700																			
GAD	029C	1023	2478																			
GDA	029C	1024	2479																			
GETBIT	056B	1904	1893	1895	1900																	
GETBYT	055A	1882	1874																			
GETP	053D	1841	1113																			
GETPTR	053A	1827	1210	1278	1809																	
GFIX	0299	1017	2476	2477	2477	2478	2479	2480	2481	2482	2483	2484										
				2485	2486																	
GMV	02E4	1112	672	2481																		
GRGAD	0299	1019	2485																			
GRGDA	0299	1020	2486																			
GRGFIX	0299	1018	2480																			
GRL	0306	1144	2482																			
GRT	035A	1226	2484																			
GTAB	076F	2476	544																			
GWT	0324	1182	2483																			
HAD	0202	839	2445																			
HDA	01EF	822	2446																			
HEX7	0689	2337	2316	2324																		
HEX7SG	0678	2314	2284	2286	2300																	
HFIX	01EC	816	2443	2444	2444	2445	2446	2447	2448	2449	2450	2451										
				2452	2453																	
HLTEMP	1FE8	2651	162	239	281	287																
HMV	0220	871	2448																			
HRGAD	0212	855	2452																			
HRGDA	0230	888	2453																			
HRGFIX	0212	856	2447																			
HRL	0220	870	2449																			
HRT	0220	868	2451																			
HTAB	074B	2443	513																			
HWT	0220	869	2450																			
IAD	0240	913	2456																			
IDA	0240	914	2457																			
IFIX	023D	908	2454	2455	2455	2456	2457	2458	2459	2460	2461	2462										
				2463	2464																	
IGNORE	03BB	1336	557	580	594	600	616	630	643	692	708	719										
			816	825	910	936	965	991	1020													
IM1AD	1FEE	2653	207	1373																		
IMV	024B	926	2459																			
INI	03C1	1347	123																			
INI1	03C7	1363	1368																			
INI2	03C9	1364	1365																			
INI3	06B3	2382	1371																			
INI4	03D8	1372	2397																			
IRGAD	025C	941	2463																			
IRGDA	025C	942	2464																			
IRGFIX	023D	909	2458																			
IRGNA	0267	952	950																			
IRL	024B	925	2460																			
IRT	024B	923	2462																			
ISTEP	0258	937	932																			
ITAB	0757	2454	524																			
IWT	024B	924	2461																			
KO	077B	2491																				
KOA	0785	2501																				
KOB	0786	2502																				

CROSS REFERENCE				MPF-I														
SYMBOL	VAL	M	DEFN	REFS														
LEAD	0360		1229	1240	1258	1272												
LEAD1	0367		1236	1246														
LEAD2	0371		1250	1251														
LOCPT	04A5		1651	1648														
LOCRG	04BE		1682	1628														
LOCRGB	04BB		1676	888														
LOCSTB	0455		1538	871	1519													
LOCSTN	045F		1550	930	988	1531												
LOOPH	058F		2001	2004														
LOOPL	0599		2008	2011														
MAIN	00DE		379	387														
MEMDP1	0402		1444	768	851													
MEMDP2	040B		1451	371	574	604	682	733	746	835	919	974	1177					
MPERIO	002A		33	2017														
MPF I	079F		2531	258														
MVUF	0300		1136	1126														
NMI	0066		266	174	1372													
NOKEY	064D		2255	2247														
NOTONE	06DD		2409	2405														
OLOOP	05B7		2042	2045														
ONE 1K	0004		47	2066														
ONE 2K	0004		48	2064														
OUTO	05C9		2057															
OUT1	05D2		2063	2056														
OUTBIT	05C4		2050	2041	2043	2047												
OUTBYT	05B1		2033	2028														
P8255	0003		15	107	276													
PERIOD	058C		1991	1236	1250	1947												
POWERU	1FE5		2645	121	2382													
PRECL1	03EE		1402	827	890	1422												
PRECL2	03FA		1416	840	875													
PREOUT	02A3		1036	562														
PREPC	0021		133	131														
PWCODE	00A5		19	122	1370													
RAMCHK	05F6		2110	130	331	334	598	628	707	824	2358							
RAMT	069A		2358	2362														
RAMTES	0694		2355															
REGBF	1FBC		2620	1049	1682													
REGDP8	0473		1600	864														
REGDP9	0477		1606	582	897	952	1006											
REG	07CA		2574	753														
RESET1	0032		181	140														
RESET2	0054		248	183														
RGNADP	04AE		1659	1624														
RGSAVE	0074		281															
RGSTIN	0479		1611	1604														
RGTAB	07D0		2580	1666														
ROMTES	06A6		2375															
RST28	0028		143															
RST30	0030		166															
RST38	0038		194															
SAV12	0412		1456	1450														
SCAN	05FE		2136	381														
SCAN1	0624		2191	1265	1364	2153	2162											
SCLOOP	0618		2162	2163														
SCNX	060D		2153	2156														
SCPRE	060B		2152	2145	2154													
SEG7	0001		17	1230	1277	2228	2234											

CROSS REFERENCE		MPF-I									
SYMBOL	VAL	M	DEFN	REFS							
SEGTAB	07FO		2596	2339							
SETIF	00A4		320	318							
SETPT	0434		1487	1491	1530						
SETPT1	0433		1486	1481							
SETSTO	00D0		353	263	332	335	347	1222			
SHORTP	057E		1966	1956							
SKIP1	0183		645	641							
SKIP2	01B8		721	717							
SQWAVE	05EA		2094	2099							
STATE	1FE4		2644	361	443	514	1396	1456	1556	1617	1637
STEPBF	1FAF		2618	623	627	645	680	706	721	723	796
				1132	1144	1153	1192	1198	1218	1227	1254
				1545	1840						1260
											1292
STEPDP	043A		1513	805	885	937	992				
STEPTA	07BC		2560	1564							
STMINO	1FE3		2643	451	859	926	942	981	996	1543	1569
				1681	1693						1618
											1643
SUM	0531		1813	2378							
SUM1	052D		1803	1183	1290						
SUMCAL	0532		1821	1823							
SUMOK	06B2		2381	2379							
SYSSTK	1FAF		2617	116	322	380					
SYS SP	07AF		2547	341							
TAPEIN	054D		1862	1257	1287						
TAPEOU	05A7		2021	1203	1213	2030					
TBEEP	1FF2		2658	2392	2402						
TEMP	1FEA		2652	1036	1048	1079	1094	1228	1267		
TERR	0587		1985	1952							
TEST	1FE6		2646	252	413	1337	1408	1413	2138		
TESTM	03E5		1389	552	569	592	614	690			
TESTRG	013E		578	571							
TLOOP	054F		1874	1877							
TNEXT	06A0		2361	2359							
TONE	05E4		2090	2087	2408						
TONE1K	05DE		2085	1197	2067						
TONE2K	05E2		2088	1209	1217	2059	2065				
UAFF	1FC4		2625	1737	1755						
UBCP	1FC6		2626								
UDEP	1FC8		2627								
UHLP	1FCA		2628								
USERAF	1FBC		2621	1068	1092	1732	1749				
USERBC	1FBE		2622								
USERDE	1FC0		2623								
USERHL	1FC2		2624								
USERIF	1FD2		2632	181	312	320	1037	1069	1717		
USERIX	1FCC		2629								
USERIY	1FCE		2630	289							
USERPC	1FDC		2637	133	285	731					
USERSP	1FDO		2631	250	288	328	1067				
USERST	1F9F		2615	249	345						
ZERO_1	0002		49	2060							
ZERO_2	0008		50	2058							
ZSUM	0071		20	191							