Notes for MSX Software Developers [2nd edition]

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This document provides important informations for the people who
write the software for MSX/MSX2 to keep the compatibility between
machines and versions. Some frequently asked questions and other
useful informations are also provided. Please read 'MSX Technical
Data Book' also for more basic informations.

1.0 HOW TO KNOW THE MSX VERSION

There are several ways how to know the MSX version on which the software is running. Followings are the recommended way to check the version number.

1. Main-ROM address 2DH contains the version information as follows:

CONTENTS OF 2DH	VERSION OF MSX
0	MSX-1
1	MSX-2
other	Not defined (reserved)

For those softwares that run in the environment where the page 0 of main-ROM is switched out with other ROM or RAM, such as the softwares under MSX-DOS, use the inter-slot read function to address 2DH with slot address stored in RAM location FCC1H (See next note).

NOTE

In MSX2, the MAIN-ROM is not always located in the slot 0 or the slot 0-0. (0-0 means the secondary slot 0 of the primary slot 0.) The address FCC1H contains the slot address of the MAIN-ROM and the address FAF8H contains the slot address of SUB-ROM. (See 3.0 The slot address of BASIC-ROM.)
This is because of the MSX-2 adaptor for the MSX-1.

2. RAM address FAF8H contains the slot address of MSX2 SUB-ROM. Since this doesn't exist in MSX1, application software is able to know whether this is MSX1 or not by the contents of this RAM location. I.e.,

CONTENTS OF FAF8H	VERSION OF MSX
0	MSX-1
other	MSX-2 or newer

As you see, this method provides only the information just the version is MSX1 or not. The MAIN-ROM address 2CH-2DH contains more information.

2.0 THE I/O ADDRESS OF VDP

In the MSX-2, the VDP is not always sitting in the address 98H-9BH.
Therefore those softwares that access the VDP directly must refer
to the MAIN-ROM address 6 and 7 to know the addresses of the VDP as
follows. This is because of the MSX-2 adaptor for the MSX-1.

VDP PORT	I/O address
VRAM read	(0006) in MAIN-ROM
VRAM write	(0007) in MAIN-ROM
Status read	(0006) + 1
Command write	(0007) + 1
Palette write	(0007) + 2
Indirect register access	(0007) + 3

3.0 THE SLOT ADDRESS OF THE BASIC-ROM

In the MSX-2, the MAIN-ROM is not always placed in the slot 0 or
slot 0-0. Also, there is another ROM called SUB-ROM which contains
the software that support new features is placed in the page 0 of
some slot. To inform those slot addresses, following RAM area contains
slot address of those ROMs.
To access the BIOS entries in those ROMs, use inter-slot call if
necessary.

Address	Label	contents
FCC1H	EXPTBL	The slot address of the MAIN-ROM
FAF8H	EXBRSA	The slot address of the SUB-ROM

4.0 EXPANDED SLOT

In the MSX2, there is a great possibility that any one of the slots
is expanded to have more slots to contain more softwares on ROM, such
as SUB-ROM, DISK-ROM, RS232-ROM and special built in software ROM.
So there should be never a software for the MSX2 that does not work
with the machine that has expanded slot.
So, please check before release your software to make it sure that
your software works in the expanded slot, and with the machine with
the RAM placed in the expanded slot.
Especially, do not access the address FFFFH as the normal RAM. This
is the address of the expanded slot select register. There are several
softwares that place the stack pointer- in this address space with
the instruction,

                 LD   SP,0000
that, of course, does not work with the machines with expanded slots.

5.0 CALLING THE BIOS

Please call the BIOS through the entry jump tables. It is the worst software that is calling the BIOS directly its location. It is never possible to keep compatibility between versions for such softwares.

6.0 THE INITIAL STATE OF THE RAM

The contents of main RAM and VRAM is undetermined otherwise stated. There are some softwares that assumes the contents of RAM is zero (we don't know the reason) and of course does not work in the different cases.

7.0 HOW TO RETURN TO THE BASIC

To return to the BASIC interpreter from the application software, do the following steps. Major work area of the BASIC should be kept unchanged. (If you don't know which is the major and which is the minor, don't touch all the BASIC work area.)
The contents of all the registers and stack are ignored.

1. Enable the MAIN-ROM slot. The slot address of the MAIN-ROM is
   stored in the RAM location FCC1H.   (See 3.0 The slot address of
   the BASIC-ROM.)

2. Jump to the location 409BH in the MAIN-ROM.

The prompt "Ok" (or in MSX-2, ·user defined prompt string) will be displayed.

8.0 ESCAPE SEQUENCES OF MSX

MSX supports the escape sequences listed on the table in appendix B. These functions are available for the PRINT statement of BASIC, CHPUT BIOS routine, CONOUT of MSX-DOS direct BIOS · call and CONSOL OUTPUT of MSX-DOS function call.
These are subset of the DEC VT-52 terminal or HEATH H-19 terminal.

9.0 WORK SPACE OF THE DISK SYSTEM

The size of the work space of the disk system varies depending on the number and capacity of the drives. The top address of the free area for the application softwares under DISK-BASIC environment is

(HIMEM)-1. (HIMEM) is a value stored in the address FC4AH(HIGH) and FC4BH(LOW).

So far, the disk system that requires the largest work space is the system with two 2DD drives. And the lowest address of the work area in this case is around DE70H.

So, with some allowance, let's make the top address of user area to DE3FH.

However, there is still a possibility that there may be a system with larger system work space. So, every application softwares must check the address stored in the HIMEM (FC4AH, FC4BH) and make sure that even in the worst case, the system does not crash. The recommended ways when the system uses more work area than the application software expects are:

1. Make the work area relocatable so that it can be located anywhere.
2. Allocate the work area from BOTTOM. This may be a good way because all the MSX2 machine has RAM from address 8000H.
3. Direct the user to reboot the system with fewer disk drives. (Refer to the next section.)
4. Halt the program after displaying the message, "Insufficient work space."

10.0 HOW TO REDUCE THE DISK DRIVES

Pressing the 'shift' key until beep sounds after the system reset (or power on) makes all the disk drives disabled. Useful when the application software does not work with the disk connected. Similarly, the 'control' key disables the two drive simulator of single drive system and the work area of the disk system become smaller.

11.0 HOW TO KNOW IF THE DISK SYSTEM IS CONNECTED OR NOT

Check the contents of the RAM whose address is FFA7H. If 'C9H' is stored, no disk is connected, otherwise disk system is connected and initialized.

After the disk system is initialized, following address contains some informations available for the applications. If the system has less disk interfaces than four, the rest of table entries are filled with zero.

Note that the contents of this table is not initialized if no disk interface exits, so make sure there is a disk interface is connected as described before.

```
         address                contents
-------------------------------------------------------------
    FB21H      Number of drives connected to the first interface
    FB22H      The slot address of the first interface

    FB23H      Number of drives connected to the second interface
    FB24H      The slot address of the second interface

    FB25H      Number of drives connected to the 3rd interface
    FB26H      The slot address of the 3rd interface

    FB27H      Number of drives connected to the 4th interface
    FB28H      The slot address of the 4th interface
```

12.0   AUTOMATIC EXECUTION OF APPLICATION SOFTWARE

For the simple application softwares like games, put start address of the software in the 'INIT' location in the ROM ID area. However, in this way, no other system softwares such as disk/RS-232C may not be initialized.
For those applications that need to have all other system softwares initialized, put inter-slot call instruction to the start address at address FEDAH. This is a hook that is called after all the system software is initialized. This method is available on the system without disk. Please refer to 'MSX-DOS BOOT PROCEDURE' in the 'MSX Technical Data Book'.

13.0   DISK ERROR HANDLING BY APPLICATION SOFTWARE

An application software may handle the disk errors. The two byte value stored in RAM whose address starting from F323H is a pointer to the pointer of the disk error handler. Change those 2 bytes so that it points the pointer to the error handler in the application software.
The kind of error is passed through register 'C' and the driver number is passed through register 'A'. The LSB of register 'C is zero if the error occurred during the read operation and 1 if the error occurred during the write operation. Bit 1 through 3 of the register 'C' represent the error status as follows:

```
b3 b2 b1  |  Kind of error
----------+-------------------
  0  0  0 |  Write protected
  0  0  1 |  Not ready
  0  1  0 |  CRC error
  0  1  1 |  Seek error
  1  0  0 |  Record not found
  1  0  1 |  Write error
  1  1  0 |  Other error
```

The returned value from the error handling routine determine the action taken by the DOS as follows. The contents of register 'C' and 'SP' must be kept unchanged. Other registers may be destroyed.

```
  C |  Action after the error
----+---------------------------
  2 |        Abort
  1 |        Retry
  0 |        Ignore
```

14.0 DOS FUNCTION CALL

The MSX-DOS function call is available under the Disk Basic environment. The RAM address F37DH is the entry for DOS function call which is equivalent to the address 5 in the MSX-DOS environment.
Refer to the 'MSX-DOS SYSTEM CALL' section in the 'MSX Technical Data Book'

APPENDIX A

SOME IMPORTANT LOCATIONS IN MSX2

Address	contents
0006H	The I/O address of VDP read port
0007H	The I/O address of VDP write port
002DH	The version number of MSX
409BH	BASIC interpreter warm start entry
F323H	Entry to disk error handling routine
FAF8H	Slot address of SUB-ROM
FB21H	Informations of disk drivers
FC4AH	The beginning address of the system work area
FCC1H	Slot address of MAIN-ROM
FFA7H	Disk is connected if the contents of this address is not 'C9'
FEDAH	Hook for auto start
FFFFH	Slot select register for the secondary slot