

SP-2-MC10

```
MICROCULUR BASIC 1.0  
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OK
```

```
SP-2-MC10 v1.12  
R reset emulator  
K show MC10 keyboard  
Q quit emulator  
U screenrefresh 1/4 D  
B back to emulator  
S sound ON
```

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1 Introduction

My first computer was a TRS 80 MC10, my second computer was a ZX Spectrum. The processor of the MC10 is slower than the Z80 from the ZX Spectrum. Can a reasonable emulator be coded on the ZX Spectrum?

1.1 History

I started the emulator in July 2023. I restarted 3 times before I got a decent method that worked as an emulator. More about the technical details in the technical chapter. This is the first finished emulator. Due to bugfixes some opcodes are broken up in multiple parts. For speed the code should be rearranged although the speed gained would be marginal.

2 The emulator

This program emulates a TRS80 MC10, a computer from 1982. Like the ZX81-emulator the same mainprogram is used to emulate each opcode. The ROM is optimized to get a higher speed.

2.1 How to start the emulator

When you have the tape of the emulator you type LOAD "" and make the tape play. The computer will load a BASIC-program and the emulator. After loading the emulator will start with the startupscreen.

2.2 What does the emulator do?

The emulator will make the ZX Spectrum react like a 8K TRS80 MC10 in standard screenmode. The processor of the computer is emulated so both BASIC and machinecode games that run on a 8K MC10 should run on this emulator. Speed of the games can be slow.

2.3 The I/O ports

The only I/O possible is by the keyboard, the screen and from/to a load/save device. There is NO CHECK when other ports are accessed and they might not work. Interrupt routines are not tested and can crash the emulator. Sound is played from the speaker. The emulator plays a sound with the routine for sound in the ROM. The sound is not (yet) the same as on the MC10.

2.4 The keyboard

The MC10 has a 48 key keyboard. The ZX Spectrum only has 40 keys. To have all keys supported on the ZX Spectrum you need to use shifted or symbol shifted keys to get all keys emulated. Like the ZX Spectrum the MC10 has keywords. The keywords can be called with 1 keycombination but you can also type a keyword letter by letter. This extra option allowed me to add the extra keys at the cost of a few keywords. The keywords CONT, RND, GOTO, STEP, SIN, COS, SOUND, RESET, READ, INT, ABS and PEEK must be typed letter by letter to use them in your code.

The keyboard is read each time a value is written to the keyboarddata. The emulator checks on each writeaction if the keyboard must be scanned.

2.5 Screen-emulation

The MC10 has multiple screenmodes. At the moment only a screen based on characters is emulated. A character on the MC10 is sized 8x12. On the ZX Spectrum I have reduced the size to 8x8. The ZX Spectrum has room to display 8x12 characters but the colours in the attributefile might clash and the display of the screen would become much slower than the current display is. This will give a 2/3 screen display of th MC10 on a ZX Spectrum. Each character on the MC10-screen has its own colour. Based on the character on the screen the colourattribute will be set. The final part of the screen is used to display the menu.

2.6 The emulator on a PC on a ZX Spectrum emulator

On a PC you can alter the speed of the ZX Spectrum emulator. This can be used to make the MC10-emulator run faster.

2.7 The Menu

The menu is activated by pressing the E-cursor (shift and symbol shift). This can only be done when the keyboard is read by the program. After pressing the E-cursor the menu appears at the bottom.

R	reset emulator	
K	show MC10 keyboard	
Q	quit emulator	
U	screen refresh 1/n	D
B	back to emulator	
S	sound ON/OFF	

R will reset the emulator and make a first plug in restart.

K will show you the keyboard of the MC10 how it is defined on this emulator. For some keys the ZX Spectrum equivalent is used. Some keywords must be typed letter by letter.

Q will end the emulator and return to the unprotected BASIC. You can use this to save the program on other devices than tape.

U and D will alter the number of screenrefreshes. This can give some speed when less updates are done.

B will return to the emulator at the moment the menu was activated.

S will toggle between sound on and sound off. This is only emulated in the BASIC command SOUND. A game with its own sound module not calling #FFAB might crash the emulator.

2.8 Change to a not defined LOAD-device

When you want to store the emulator on a microdrive or other storage with a different LOAD-command than tape then you can alter line 512, line 9911 and line 9912. Before you alter the line create some room in BASIC with CLEAR 3E4. Your altered line must in the end fit in the memory allocated by the CLEAR 24570.

2.9 How to load a game

You can load a BASIC game by typing CLOAD. The emulator will now use the Sinclair BASIC to load a game. An input is asked for a name. No name will load the first find game on the tape. After loading the emulator continues with the OK message after loading. The S, F and name of the game is not shown on the screen but the game has loaded. You can now run the game.

To load a machinecode program you type CLOADM. After ENTER the same input as loading BASIC is used. After loading you can start the machinecode with the command EXEC.

Games from the MC10 need to be converted into a tape format the ZX Spectrum understands. The tool MC10-2-SPTap.Z80 can do that job.

3 Technical manual

3.1 The memory layout

The MC10 has a whole different memory layout from any Z80 computer.

#0000 #00FF zeropage RAM memory

#4000 #nnnn RAM memory (depending on RAMpack how much RAM) starting with screen

#E000 #FFFF ROM memory

On a ZX Spectrum the memory is :

#0000 #3FFF ROM

#4000 #5AFF Screen

#5B00 #5CCB Systemvariables

#5CCC #FFFF RAM for BASIC or machinecode

A large part of the code can therefore not run at its own addresses.

To make a working emulator the MC10-memory is stored at the following addresses.

#8000 zeropage

#C000 RAM

#BFFF keyboarddata

#E000 ROM

RAM is therefore dislocated from the real address, but each address in both ROM and RAM can be found by setting bit 7 of the address. That is how the emulator works.

3.2 The mainprogram

Each opcode of the 6803 must be emulated with a number of opcode of the Z80 to get the same result.

Each opcode must go to its own piece of code to run that code. To determine which part of code must be executed the following main program

```
LD    A,(DE)      ; DE=programcounter, so A now holds opcode
LD    L,A         ; lowbyte of routine is the opcode
LD    H,table     ; point to a table
LD    H,(HL)     ; fetch highbyte from the table
JP    (HL)       ; go to the routine needed
```

This short and powerfull routine is used in multiple emulators that run on a 8 bit computer.

3.3 Userdefined instruction

The 6803 has multiple unused opcodes. These opcodes are used to activate other routines. At this moment opcode #15 and #18 are used for user defined instructions.

#15 will play a sound

#18 triggers Spectrum BASIC to load a game.

Other codes will be used to translate parts of the ROM to make the BASIC faster.

3.4 Known issues

No support of loading datafiles or add a name or loadaddress. You can only load how it is stored on tape.

3.5 Bugreport

If a game gets in a loop where at left top 1 byte keeps changing and you can reproduce that effect then please report that to DR BEEP!

4 Conversion

On a PC with a ZX Spectrum emulator you can convert games for the MC10 into a format that can load into a ZX Spectrum. The MC10 loads a block of data and then has a (small) header for the next block until all data has loaded. The ZX Spectrum needs a continuous block of data,

With the tool MC10-2-SPTap.z80 you can load a game of the MC10-PC emulator (.C10 file) into the memory and then a program will save the game in a ZX Spectrum format. How to define a tap-file to save to is a specific item in the emulator, see the manual of the Spectrum-emulator how to do it

5 Future development

Extra speed can be added if more routines from the ROM are translated as Z80-code. However... the speed did not improve much when I altered the latest routines. This made me think that further translating is a lot of work and not worthwhile the effort it takes. At this moment I don't have further development ideas.