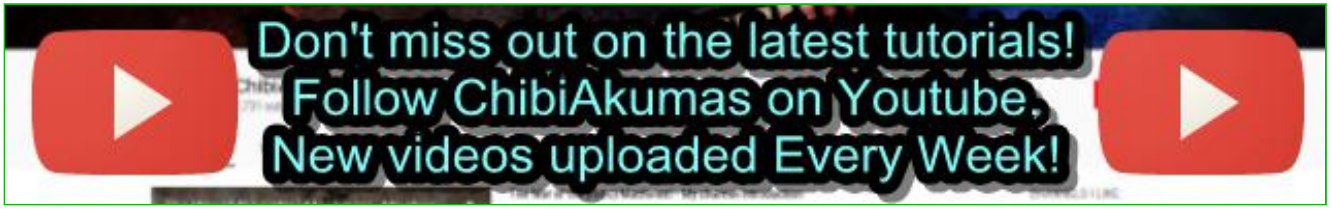

View Options
Default Dark
Simple (Hide this menu)
Print Mode (white background)

Top Menu
Main Menu
Youtube channel
Forum
AkuSprite Editor
Dec/Bin/Hex/Oct/Ascii Table

Z80 Assembly programming for the ZX Spectrum

When I was young, The ZX Spectrum was the cheapest of the 8 bits, and frequently looked down upon by CPC and C64 owners... Despite its more limited graphics, they do yield some interesting advantages... compared to the CPCs 4 color mode 1... the ZX Spectrum has similar resolution, and twice the onscreen colors - what's more, it uses half the screen memory which means Spectrum games are often significantly smoother than their CPC equivalents...

These days, clever developers are able to work around the spectrums color limitations, and produce impressive looking games with fast gameplay on this classic 8 bit.

Cpu	3.5mhz Z80	3.5mhz Z80
Ram	48k/128k	128k
Vram	8k	8k

Z80 Content
Z80 Tutorial List
Learn Z80 Assembly
Hello World
Advanced Series
Multiplatform Series
Platform Specific Series
ChibiAkumas Series
Grime Z80
Z80 Downloads
Z80 Cheatsheet
Sources.7z
DevTools kit

Resolution 4-color	256x192 8 color / 2 brightness per 8x8 tile	256x192 8 color / 2 brightness per 8x8 tile
Sound chip	Beeper	AY-3-8910

Z80 Platforms
Amstrad CPC
Elan Enterprise
Gameboy & Gameboy Color
Master System & GameGear
MSX & MSX2
Sam Coupe
TI-83
ZX Spectrum
Spectrum NEXT
Camputers Lynx

Chibiakumas Tutorials:

	Lesson H2 - Hello World on the ZX Spectrum
	Lesson P1 - Basic Firmware Text functions
	Lesson P2 - More Text Functions, Improvements... and the Sam Coupe!
	Lesson P4 - Bitmap graphics on the ZX Spectrum and Sam Coupe
	Lesson P6 - Keyreading on the Amstrad CPC, ZX Spectrum and Sam Coupe
	Lesson P18 - Making Sound with the AY-3-8910 on the Amstrad CPC, MSX,ZX Spectrum.... and NeoGeo + Atari ST!!
	Lesson P23 - Sound with the 'Beeper' on the ZX Spectrum and Apple II
	Lesson P26 - Bankswitching and hardware detection on the ZX Spectrum
	Lesson P35 - Playing Digital Sound with WAV on the AY!
	Lesson P37 - Playing Digital Sound with WAV on the Sam Coupe, Camputers Lynx and ZX Spectrum

6502 Content
6502 Tutorial List
Learn 6502 Assembly
Advanced Series
Platform Specific Series
Hello World Series
Grime 6502
6502 Downloads
6502 Cheatsheet
Sources.7z
DevTools kit
6502 Platforms
Apple IIe
Atari 800 and 5200
Atari Lynx
BBC Micro
Commodore 64
Commander x16
Super Nintendo (SNES)
Nintendo NES / Famicom
PC Engine (Turbografx-16)
Vic 20

AY-3-8910 Sound Chip:

Register	Meaning	Bit Meaning	Details
0	Tone Pitch L - Channel A	LLLLLLLL	Lower value = Higher pitch
1	Tone Pitch H - Channel A	----HHHH	Lower value = Higher pitch
2	Tone Pitch L - Channel B	LLLLLLLL	Lower value = Higher pitch
3	Tone Pitch H - Channel B	----HHHH	Lower value = Higher pitch
4	Tone Pitch L - Channel C	LLLLLLLL	Lower value = Higher pitch

68000 Content

5	Tone Pitch H - Channel C	----HHHH	Lower value = Higher pitch
6	Noise Generator	---NNNNN	Higer = Faster noise
7	Mixer	--NNNTTT	N=Noise T=Tone (Channel --CBACBA 1=mute 0=normal)
8	Amplitude - Channel A	---EVVVV	E=Envelope (1=Enabled) VVVV=Volume
9	Amplitude - Channel B	---EVVVV	E=Envelope (1=Enabled) VVVV=Volume
10	Amplitude - Channel C	---EVVVV	E=Envelope (1=Enabled) VVVV=Volume
11	Envelope L (Volume over time)	LLLLLLLL	Lower=Faster Envelope
12	Envelope H (Volume over time)	HHHHHHHH	Lower=Faster Envelope
13	Envelope Selection	----EEEE	Envelope number (See PDF)

For more details, please see the **AY sound chip PDF**

Beeper Sound Chip:

The "Beeper" sound chip is incredibly crude... it is controlled by bit 5 of the port &FE... by turning it on and off we can make simple sounds...

See the example to the right... by changing the pause (caused by BC) we can change the pitch of the sound... 3000 will be a relatively low pitch... 500 will be higher...

Some clever programs even manage to "Fake" multiple sound channels!

The big disadvantage to all this is that the CPU will be busy during the whole time, so the Beeper chip isn't very helpful, and we'll want to use the AY sound chip on the 128k systems... but on the 48k machines, it's all we've got!

```
    xor a
loopy:
    xor %00010000
;---S-BBB
S=Sound B=Border
    out (&fe),a
    ld bc,3000
;Lower
number=higher pitch
pausey:
    dec c
    jr nz,pausey
    dec b
    jr nz,pausey
    jr loopy
```

Ram Banking

Ram banking is controlled by port &7FFD and &1FFD - they can be written, but not read, therefore, you should keep a backup of the value last sent to this port... by default the firmware keeps one at &5B5C and &5B67

Port	Backup	Bits	Details
&7FFD	&5B5C	- - IRSMMM	MMM= ram bank at C000 (0-7) S=Screen page bit R=Rom Low bit I=I/O Disabling

68000 Tutorial List
Learn 68000 Assembly
Hello World Series
Platform Specific Series
Grime 68000
68000 Downloads
68000 Cheatsheet
Sources.7z
DevTools kit
68000 Platforms
Amiga 500
Atari ST
Neo Geo
Sega Genesis / Mega Drive
Sinclair QL
X68000 (Sharp x68k)

8086 Content
Learn 8086 Assembly
Platform Specific Series
Hello World Series
8086 Downloads
8086 Cheatsheet
Sources.7z
DevTools kit
8086 Platforms
Wonderswan
MsDos

ARM Content
Learn ARM Assembly
Platform Specific Series
ARM Downloads
ARM Cheatsheet
Sources.7z
DevTools kit

&1FFD	&5B67	- - - SDR - P	P = paging mode (0=norma 1=+3) R=Rom high bit D = Disk Motor S=Printer strobe

The ZX Spectrum 128 has 4 banks of 16k, the first is always rom on the 128k... the +3 CAN have ram in this bank, but this will mean you cannot support the 128k system (only about 15% of spectrums on the market are +3's)
Note... the Black +2 has the same hardware as the +3... the Grey +2 has the same hardware as the spectrum128 system

ZX 128K	
&0000	ROM
&4000	*Screen 1 (5)**
&8000	Ram (2)
&C000	***Screen 2 (7)***

* ZX Firmware uses &5B00-&6000

Ram Contention

'Contention' is banks of memory which are slower due to sharing with the screen memory, unfortunately, the banks that are contended are different on the 128k machines and the +3

128K	+3
Ram 0	Ram 0
Ram 1	Ram 1
Ram 3	Ram 3
Ram 4	*Ram 4*
Ram 6	*Ram 6*
Dark=Contended	

Spectrum +3 Ram Options

As Mentioned, the spectrum +3 has some special banking options, which were used to allow CPM to work on the Spectrum - they are enabled by setting bit 0 of &1FFD to '1' to turn on this special mode

	&1FFD Bits 2,1			
	00	01	10	11
&C000	Bank 3	Bank 7	Bank 3	Bank 3
&8000	Bank 2	Bank 6	Bank 6	Bank 6
&4000	Bank 1	Bank 5 (S)	Bank 5 (S)	Bank 7 (S)
&0000	Bank 0	Bank 4	Bank 4	Bank 4

	S=Screen Bank

Memory Map

48k		Usage
0000	3FFF	ROM
4000	57FF	Screen Ram
5800	5AFF	Screen Ram Color Data
5B00	5BFF	Printer Buffer (Sysvars on +3)
5C00	5CBF	System Vars
5CC0	5CCA	Reserved
5CCA	5D3B	TR-DOS Area
5D3B	FF57	Available Memory (Between Prog and Ramtop
FF58	FFFF	Reserved (User defined characters)

Spectrum +3 Disk File Header

Position	Bytes	Content	Details	Example
&0000	8	PLUS3DOS	Text Header	PLUS3DOS
&0009	1	EOF byte	EOF Character	26
&000A	1	Issue Num	Issue Num	1
&000B	1	Version Num	Version Num	0
&000F	4	Size+128	Size INC Header	&1080
&0010	2	Size	Size of file	&1000
&0012	5	Basic Header	Basic Header	&03,&00,&80,&00,&80
&0017	104	Unused	Unused	0 0 0 0
&007F	1	Checksum	Checksum of Header bytes 0-126 (MOD 256)	?
&0080	Program Code			

Spectrum Links

Fuse - My Spectrum emulator of choice!
Spectrum 128k and **Spectrum 48K** reference - Great summary of the hardware - provides much of the info you'll

Dragon 32/Tandy Coco
Fujitsu FM7
TRS-80 Coco 3
Vectrex

My Game projects
Chibi Aliens
Chibi Akumas

Work in Progress
Learn 65816 Assembly
Learn eZ80 Assembly

Misc bits
Ruby programming

want for ZX dev

Basic Manual - You'll want to know at least enough basic to do calls and operate the computer

Spectrum Computing Forum - Web community full of helpful people!

General Z80 Assembly Tutorials:

B. Beginner series - Learn the basics

A. Advanced series - In more detail

M. Multiplatform series - programming methods that work on all systems

Recent New Content

[6809 Lesson 5 - More Maths - Logical Ops, Bit shifts and more]

[x68000 Hardware Sprites]

[Joypad & Pen on the GBA / NDS ... Key reading on Risc OS]

[C64 Hardware Sprites - 6502 ASM Lesson YQuest14]

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ASM Tutorials for
Z80,6502,68000
8086,ARM and
more On my
Youtube Channel

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Advice?
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