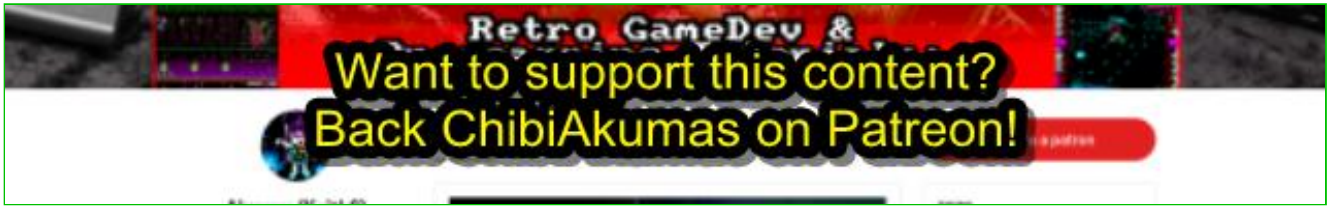

View Options
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Simple (Hide this menu)
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Z80 Assembly programming for the Spectrum Next

The Spectrum Next is a FPGA based enhanced version of the ZX Spectrum

A Kickstarted was completed May 2015 - and many of the backers have their hardware, however at the time of writing it's not possible for the public to buy the machine,

Despite this, we can write software for the Spectrum Next using emulation

	ZX Spectrum	Spectrum NEXT
Cpu	3.5mhz Z80	3.5 / 7 / 14 mhz Z80
Ram	48k/128k	1024k
Vram	8k	48k
Resolution 4-color	256x192 8 color / 2 brightness per 8x8 tile	40x32 4bpp Tilemap 256x192 256 Color BMP

Hardware Sprites	none	128 sprites 16x16 pixel - 256 color
Sound chip	Beeper	3x AY-3-8912 / SpecDrum

Setting Up Zesarux for Spectrum Next with MMC

By Default Zesarux will need some setup to emulate the Next... otherwise you'll get an 'Error initializing SD card!' errror...

We need to set up the Boot MMC... to do this, go to the **Storage** menu and select **MMC**

Select the MMC file, and enable **MMC Emulation**, and **DIVMMC Ports**

Now go to the Machine menu, and select VTrucco/FB Labs ... then TBBLue

You'll probably get a black screen with a green border and a LOT of beeping!

Go into **Settings** and **Display**... and turn on **Real Video**

Then press enter to start the Next boot.

Fast booting for developing!

The NEXT brings the speccy really into the 21st century... in the sense that it takes a blooming age to boot!

Fortunately, if we're just using the graphics hardware, we can disable the firmware, and basically just boot to a 48k speccy rom.

In the **Settings** menu select the **hardware** menu, and enable **TBBlue fast boot mode** - Our emulator will boot much faster!

Now, this is all well and good, but we probably want to start our emulator from a batch script, below is the startup command I use, with a custom config file specified (in the same folder as the emulator), this will load quickly as a Spectrum Next, with the tape file **'\%tapefile%'** - Just specify a valid spectrum TAP file..

zesarux.exe --machine TBBlue --tape **\%tapefile%** --configfile .zesaruxrc --tbblue-fast-boot-mode --nosplash --nowelcomemessage --quickexit

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Spectrum NEXT
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68000 Content

Want to know how to create a valid TAP file for the Spectrum NEXT? we'll it's exactly the same as the regular spectrum... **see my Hello World tutorial Here**

Bitmap Hello world in 256 color mode (Layer 2) example!

Lets create a simple(ish) 'Hello World' that uses a bitmap font in 256 color mode.

Download the Sourcecode (ZXN_HelloWorld_WithMonitor.asm)

Want to learn how to make a TAP? see my Spectrum Hello World Tutorial

Watch on Youtube

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Setting up our screen!

We're going to use two of the Spectrum Next's special Z80 commands... these cant be compiled by our assembler, so we'll define macros to compile the bytecode,

These commands will set the 256 internal registers of the NEXT quickly - which is what we need to use the 256 color hardware

These could also be simulated by an OUT to &243B (with the register number) and then an OUT to &253B (with the value)

```
macro nextreg,reg,val
    db &ED,&91,\reg,\val
endm

macro nextregA,reg
    db &ED,&92,\reg
endm
```

We're going to start our code at &8000 - but this is not a special requirement of the NEXT... it's just how my loader code works for my spectrum tapes.

```
Org &8000                ;Code Origin
di
```

We're going to set a few registers to get our palette set up &43 selects our palette... and then &40 selects the next palette entry we're going to change...

We then write 1 byte per color to Next Reg &41 to set each color - each takes a single byte in %RRRGGGBB format

```
                ;IPPPSLUN
    nextreg $43,%00010000    ;Layer 2 to 1st palette

    nextreg $40,0            ;palette index 0

    ld b,4
    ld hl,MyPalette
paletteloop:
    ld a,(hl)                ;get color (RRRGGGBB)
    inc hl
    nextregA $41             ;Send the colour

    djnz paletteloop         ;Repeat for next color

MyPalette:
       ;RRRGGGBB
    db %00000001     ;Dark blue
    db %11111100     ;Yellow
    db %00011111     ;Cyan
    db %11100000     ;Red
```

Ok, we've set up our palette... but lets make sure our Layer 2 screen is set up right...

We need to reset the hardware scroll so Byte 0 is the top left of the screen... we do this with Next Registers &16 and &17

We also want to define the Layer 2 (256 color layer) screen area to make it cover the normal screen (0,0)-(255,191)... we do this with 4 consecutive writes to &18

```
;nextreg $14,%00000001   ;Transparency color (RRRGGGBB)

nextreg $16,0           ; Set X scroll to 0
nextreg $17,0           ; Set Y scroll to 0

nextreg $18,0           ;X1
nextreg $18,255         ;X2
nextreg $18,0           ;Y1
nextreg $18,191         ;Y2
```

Ok... So we want to SEE Layer 2... well actually we want to change it too!
We do this by OUTing port &123B... Bit 1 of this port makes the screen visible... Bit 0 allows us to write to it by writing to the usually ROM area at &0000-&3FFF

&0000-&3FFF will still read as ROM... but writes will go to the screen... however the screen is 48k, and the &0000-&3FFF area is only 16k... so we need to split the screen into 3 banks... these are selected with Bits 6 and 7

As a bonus, lets turn the CPU to fast mode (14mhz) we do this by writing 2 to Next Register &07

```
;Enable Layer 2 (True color screen) and make it writable

    ;BB--P-VW      -V= visible W=Write  B=bank
ld a,%00000011
ld bc,&123B
out (c),a

nextreg &07,2           ;CPU to 14mhz (0=3.5mjz 1=7mhz)
```

Test Pattern!

Lets fill the top 1/3rd of the screen with consecutive bytes... this will allow us to see all the colors the SpecNext offers us!
We'll loop

```
    ;Test Pattern

    ld de,&0000             ;&0000-&3FFF is currently VRAM
    ld bc,&4000             ;Fill &4000 bytes
FillColorsAgain:

    ld (de),a               ;write a byte to VRAM
    inc de
    inc a
    dec c
    jr nz,FillColorsAgain
    dec b
    jr nz,FillColorsAgain
```

We can see the result to the screen!

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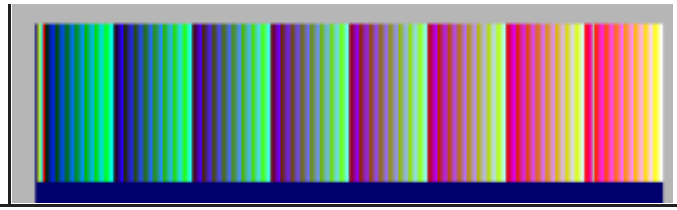


Screen locations and Printing A character

We're going to create a function to return a memory location in HL based on an X,Y co-ordinate in B,C

We'll also page in the correct memory bank in the &0000-&3FFF

Because each line is 256 pixels - and each pixel is 1 byte... it's easy to calculate...

The low byte of the address is just the Xpos... and the high byte is the Ypos... BUT - we need to deal with the banking... so we take the top 2 bits off the Ypos, and use these as the bank number...

We use these two bits with port &123B to page in the correct bank in the &0000-&3FFF range - and return the address in that range in HL

```
GetScreenPos:   ;return memory pos in HL of screen co-ord B,C (X,Y)
    push af
    push bc
        ld l,b


        ld a,c
        and %00111111           ;Offset in third
        ld h,a

        ld a,c
        and %11000000   ;Bank in correct third for &0000-&3fff

            ;BB--P-VW       -V= visible W=Write  B=bank
        or  %00000011

        ld bc,&123B
        out (c),a       ;BB---P-VW  - Page in and make visible
    pop bc
    pop af
    ret
```

Lets create a PrintChar command - to show the Accumulator from our bitmap font!

We'll use the 1bpp font we used in the main tutorials... it has no characters below character 32, and uses 8 bytes per character...

We subtract 32 from A, and multiply it by 8 to calculate the offset in our font of the character we want...

Next we load the X,Y pos of the 'cursor' from address CursorX and CursorY... each character is 8x8 pixels, so we multiply both by 8, and use GetScreenPos to calculate the address the character should be printed.

```
PrintChar:                      ;Print A to screen
    push af
    push bc
    push de
    push hl
    push ix
        sub 32                  ;First Char in our font is 32

        ld h,0                  ;8 bytes per character
        sla a
        rl h
        sla a
        rl h
        sla a
        rl h
        ld l,a

        ld de,BitmapFont        ;Add Location of Bitmap font
        add hl,de
        ex de,hl

        ld a,(CursorX)          ;8 bytes per char X
        rlca
        rlca
        rlca
        ld b,a
        ld a,(CursorY)          ;8 Bytes per Char Y
        rlca
        rlca
        rlca
        ld c,a
        call GetScreenPos    ;(B,C)->HL memory - also pages in ram to &0000-&3FFF
        ld ixl,8
PrintChar_NextLine:
        push hl
            ld b,8
            ld a,(de)           ;Read in a byte from the font
            ld c,a
PrintChar_NextPixel:
            xor a
            rl c                ;Pop of left most bit
            rl a
            ld (hl),a           ;Write pixel to screen
            inc hl
            djnz PrintChar_NextPixel ;Next pixel
        pop hl
        inc h                   ;INC Y pos
        inc de
        dec ixl
        jr nz,PrintChar_NextLine
```

We need to convert our 1bpp font into 8bpp screen bytes... we do this by reading each byte of our font from DE,

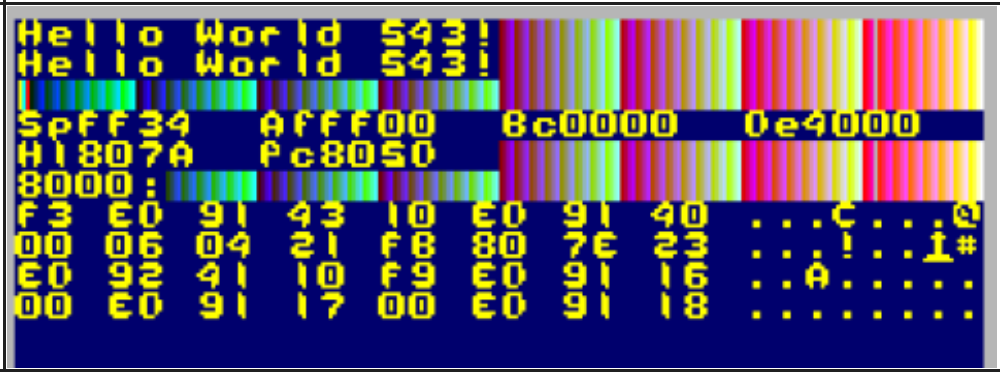
Our Screen address is in HL... we back this up with a PUSH HL

We shift a bit off the left of the byte, and put it into a screen byte... we repeat this 8 times (with B as a counter)... we've done one line...

Now we need to do the next line... we restore the old address with POP HL... as each line is 256 bytes wide... INC H will move us down a line...

We now use IXL as a counter for the 8 lines of our font.	

We've printed the character, but we want to increase CursorX so the next character will be printed to the right of the last...
 	
we also need to check if we've reached the end of the line, and move down a line with the NewLine function
	``
	    ld hl,CursorX ;Increase X
	    inc (hl)
	    ld a,(hl) ;At end of screen? (col 32)
	    cp 32
	    call z,NewLine ;Next line of our font
	pop ix
	pop hl
	pop de
	pop bc
	pop af
	ret
	``

The result can be seen!	

Download the Sourcecode (ZXN_HelloWorld_WithMonitor.asm)

Want to learn how to make a TAP? see my Spectrum Hello World Tutorial

Z80 Extended commands and macros

The Spectrum Next CPU isn't just a faster processor, it has special commands added to it... if our assembler does not support them, we can emulate these with macros, or use alternate commands.

Instruction	Function	Macro with Bytecode	Equivalent commands
NextReg n,A	Set one of the Spectrum Next exclusive hardware registers from Accumulator	macro nextregA,reg	push bc ld

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		db &ED,&92,\reg endm	bc,&243B push af ld a,\reg out (c),a inc b pop af out (c),a pop bc

NextReg n,v	Set one of the Spectrum Next exclusive hardware registers	macro nextreg,reg,val
		db &ED,&91,\reg,\val
		endm
			push bc
			ld bc,&243B
			push af
			ld a,\reg
			out (c),a
			inc b
			pop af
			ld a,\val
			out (c),a
			pop bc

GetNextReg v	Read a Next reg	(No byte equivalent)	macro GetNextReg,reg
			push bc
			ld bc,&243B
			ld a,\reg
			out (c),a
			inc b
			in a,(c)
			pop bc
			endm

OutiNB	Out (C),(HL)... inc HL (BC Unchanged)	macro outinb db &ED,&90 endm	outi inc b
Mirror	Swap bits in Accumulator %76543210 -> %01234567	macro mirror db &ED,&24 endm	
PixelAd	Get pixel Address of (X,Y) co-ordinate (E,D) on standard screen... returned in HL	macro PixelAd db &ED,&94 endm	

PixelDn	Move HL down one pixel line on standard screen	macro PixelDn db &ED,&93 endm	

Spectrum Links

Spectrum Next Wiki
ZESAURX - Spectrum Next Emulator (Called TBBlue)

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

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